

**ROAD MAP FOR  
HUMAN RESOURCE DEVELOPMENT  
IN  
HIGHWAY SECTOR**



**INDIAN ROADS CONGRESS  
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# **ROAD MAP FOR HUMAN RESOURCE DEVELOPMENT IN HIGHWAY SECTOR**

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## CONTENTS

S.No.		Page No.
	Personnel of General Specifications & Standards Committee (GSS)	(i)
	Introduction	1
Chapter 1	Development of Highways Sector	5
Chapter 2	Road Hierarchy System	15
Chapter 3	Advancements in Road Sector	19
Chapter 4	Core Organizations	24
Chapter 5	Other Related Organizations	41
Chapter 6	Organizational Requirement	50
Chapter 7	HR and HRD Spectrum	60
Chapter 8	HRD Terminology and Their Linkages	65
Chapter 9	Identification of Learning, Training and Development Needs	82
Chapter 10	Planning and Designing of Training and Development	98
Chapter 11	Instructional Strategies	110
Chapter 12	Delivering Training and Development	123
Chapter 13	Assessment and Evaluation	132
Chapter 14	Documentation for HRD & HRB	136

## **Annexes**

1.	Categories of Learning	146
2.	An Indicative List of Jobs Description Performed in Highways Sector	147
3.	Analysis Template	153
4.	Learning Objective Map	166
5.	Learning Domains Taxonomy	167
6.	Various Types of Training/System Methods	171
7.	Typical Template for the Trainer for 180 Minute Training Session	176
8.	Indicative Training Programme Module for Designing Flexible Overlays Using FWD	178
	ABBREVIATIONS	180

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## INTRODUCTION

Human resource is the productive power in human beings. Unlike the material resources, human resources are the participants as also the beneficiaries of economic development. In that sense, human resources figure both on the demand as well as supply side of production of goods and services. On demand side, goods and services produced are used by human being for general amelioration of quality of life like alleviation of poverty, improving health, improved access to market etc. On supply side, human resources and capital form the essential ingredients of production system which transform the natural and physical resources into goods and services by developing infrastructure.

In the past road sector projects were executed in small reaches with limited technology application. Qualified Engineers were managing road works but human resources developed for the Workmen were generally non-formal and informal in nature with on job transfer of knowledge by hands on training by master craftsman who had acquired skills and knowledge of the trade by way of his long experience on the job and from his mentors. With the rapid advancement in the field of technology to meet the challenges posed by national development policies, human resources need to be developed in a more structured fashion to create a net surplus of capability required to meet the challenges effectively and efficiently. Assessment of human resources needed for Highway sector in future based on projections of urbanization, port development, connectivity corridors etc. will be needed on realistic basis. Macro level forecasts at national, regional or state level for human resources for highway sector are needed for planning education pedagogy and training facilities, decision making for highway infrastructure development in matters of choice of technology, prioritization of sector development etc. Micro forecasts at enterprise level are needed primarily for planning, recruitment, and training in accordance with the development plans of enterprise.

Highway sector due by its nature serving public at large, lies majorly in Public sector domain with Government or its agencies acting as major player and funded by public exchequer. Government organizations like PWDs due to their sheer inertia with vertically linked bottom heavy organization structure, over the period failed to keep pace with the demand placed by the highway sector growth. Capability shortage of the public organizations to meet the challenges in the field of technology, quality specifications, and higher level of financial prudence required in project execution coupled with limitation of funds for highway infrastructure development forced the public organization to involve private sectors as partners in the highway sector development. Contractors, Private Project Consultants, Planning Consultants, Design

Consultants, Supervisors, third party quality assurance are new players who are now well entrenched and become indispensable to the execution of any major highway project. Capability deficit of organizations is thus compensated by transferring and sharing the competence with those who possess it.

Like any other infrastructure sector, expanse, width and depth of Highway Sector covers various primary and complementary agencies - their organizations, professionals working under them, policies governing their evolutions, their likely future configurations, technology interventions, development of new and innovative instruments for project delivery, safety and environmental concern etc. to name a few. The present document seeks to explore the dynamics of Highway Sector and its players contributing to the growth and development of highway sector and followed by developing a structured training and development manual which will serve as a tool kit for the highway professionals. This T&D manual can also be effectively utilized by different organizations the same being diagnostic and generic in nature.

The flow and sequencing of the chapters in this Manual have been arranged with a view to open up to the reader the dimensions and complexity of very many players- some in the direct, some in support, some in regulatory and other support organizations/ groups/bodies, all contributing to the highway development covering research, planning, design, development, construction, asset maintenance and management.

**Chapter 1** brings out the journey covered so far since the first planned highway development exercise was undertaken in 1927, covering various Road Development Plans that followed Jaykar Committee, opening up to the reader the shift in strategies adopted for road development over the period and the simultaneous feel of growing complexity in terms of organizational interaction, standards and specifications and demands placed on the agencies by the growing concern for sustainability aspect of growth. **Chapter 2**, deals with the present day scenario of highway sector in terms of demands placed on the highway sector which is to be serviced within a given time frame by the various highway players. These two chapters thus orient the reader to appreciate the expanse and depth of Indian highway sector and its various attributes which culminate through enormous efforts by those involved in the highway sector development into an apparently simple highway network with comfortable riding quality to the highway user. **Chapter 3** brings out to the reader the complex web of various highways players doing the job some in parallel, some supporting, a few others as regulatory and other support functions. The combined efforts of them cumulatively result in the optimal matrix of planning, design, construction, management and maintenance of highway assets. This chapter also sensitizes the reader as to the efforts required to be made in the field of HR development, HR planning and



organizational development before the challenges of future demands as described in **Chapter 2** can be met successfully. Coming to more specific, **Chapter 4 and 5** describe various organizations/agencies which are engaged in the highway sector development directly and in complementary manner. These chapters thus open up vistas of highway sector players and shows the richness of organizations/bodies spread all over the country involved in the complex interplay of highway sector development. **Chapter 6** deals more specifically the organizational requirements for various organizations in government/private sector involved in the field of highway planning , design, development, execution, maintenance and quality assurance. Such organizational requirements at individual level call for HR development which is to be dovetailed with the development at group, process and organization level to enable organization to function efficiently and competitively. **Chapter 7** briefly describes the concept of human resources and human resource development to give meaning to the task involved for training and development of professionals involved in direct or complementary and other support organizations as described in **Chapter 4 and 5** and are engaged in the discharge of their defined roles and responsibilities. This chapter further explores the concept of HRD and briefly highlights the linkages of HR development with HR management and organization development. It intended to help one understand the tasks involved for dealing with the issues dealt in **Chapter 6** on Organizational Requirement within the context of HRD. Before dealing with the T&D strategies, it is considered essential that reader should become conversant with the meaning of various terms and terminologies used in explaining the T&D related activities. Towards the end **Chapter 8** describes briefly various terminology and their linkages as will be used in subsequent chapters. **Chapter 9 to Chapter 13** deal with various steps viz. identification, design, development, implementation, and review of T&D road map. These chapters are in self explanatory sequences with examples wherever considered essential to help enable organizations described in **Chapter 4 and 5** to develop training and development system on a scientific footing using system approach. These chapters are intended to cover the steps as considered essential to transfer knowledge and skills for creating abilities and attitude among the recipients in scientific manner to make T&D program effective and useful.

HRD being comparatively new discipline in its present understanding is not so far viewed as an independent professional management tool but rather treated as an derivate of organizational requirement to deal with new emerging situations with no special consideration. **Chapter 14** deals with the issues relating to HR development and management within the over all context of highway sector organization development which is felt essential to translate vision of capacity building of organizations into a reality. This chapter also describes various issues which will be dealt by HRD Committee and includes restructuring of organizations, training of professionals, workmen training etc.

The Road Map for Human Resource Development in Highway Sector had been under the consideration of Human Resource Development Committee (G-2). The draft was discussed by G-2 Committee in a number of meetings.

The Human Resource Development Committee (personnel given below) in its meeting held on 17.04.2010 finalized the Document and recommended its submission to the General Specifications & Standards Committee (GSS) for its consideration.

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The draft Document was approved by the General Specifications and Standards Committee (GSS) in its meeting held on 24.04.2010 and the Executive Committee in its meeting held on 10.05.2010 and authorized the Secretary General, IRC to place the same before Council. The document was approved by the IRC Council in its 191<sup>st</sup> meeting held on 22.05.2010 at Munnar (Kerala). The Convenor, Human Resource Development Committee (G-2) was requested by DG (RD) & SS to incorporate the comments offered by the Council members. The document after incorporation of comments was approved by the Convenor, GSS Committee for printing.

## CHAPTER 1

# DEVELOPMENT OF HIGHWAYS SECTOR

## 1 Early Twentieth Century

**1.1** During the early Twentieth Century, the worsening condition of roads in our country was a matter of public concern, which found expression in the deliberations of the Council of States. Following a debate in the Council, Government of India appointed the Road Development Plan Committee in 1927. The recommendation of this Committee, popularly known as Jayakar Committee was emphatic regarding inadequacy of Indian road system. The Committee urged that further development of the road system was desirable for general welfare and movement of men and material. Pursuant to recommendations of the Jayakar Committee, the Central Road Fund (CRF) was constituted in 1929 as a non-lapsable fund. The revenue for CRF was generated out of the proceeds from Customs and Excise Duties levied on petrol and diesel.

**1.2** In 1930, the Office of the Special Chief Engineer was established to administer the newly constituted Central Road Fund and to advise the Government of India in all matters concerning road development. Later on, it was renamed as the Office of the Consulting Engineer (Roads) to the Govt. of India and its activities expanded during World War II. Besides, in 1934, as per Jayakar Committee's recommendations, Indian Roads Congress (IRC) was established as a body of professional highway engineers, to oversee development and set standards and procedures. The formation of the IRC set the pace for the road development in the country.

## 2 First Road Development Plan—1943-1961 (Nagpur Plan)

**2.1** The World War II saw rapid growth in road traffic and transportation, but the lack of commensurate maintenance caused deterioration in condition of roads. The first attempt to unify road system on all India basis was initiated in 1943 when the First Road Development Plan, popularly known as 'Nagpur Plan' on a uniform pattern was prepared to serve the needs of the country. The road connectivity targets set for the Nagpur Plan were as follows:

- i) In highly developed agricultural area, no village will be more than five miles from a "main road" and the average distance will be less than two miles in most cases.



- ii) In non-agricultural areas, no village will be more than 20 miles from a “main road”.

**2.2** The roads were classified into five categories: - (i) National Highways, (ii) State Highways, (iii) Major District Roads, (iv) Other District Roads and (v) Village Roads. In the above classification, National Highways, State Highways and Major District Roads constitute ‘Main Roads’, whereas Other District Roads and Village Roads constitute ‘Rural Roads’.

**2.3** Major factors governing selection of road alignment and construction were identified as under:

- i) Need of semi-developed and underdeveloped areas including forests and agricultural areas.
- ii) Location of administrative headquarters, places of pilgrimage, health resorts, tourist centres, universities etc.
- iii) Location of industries, commercial centres, big railway junctions, ports etc.
- iv) Strategic needs of the country.

**2.4** On 01.04.1947 National Highways came into existence, when the Government of India assumed responsibility for the development and maintenance of certain roads and provisionally named as National Highways. In 1956, the Government of India enacted the National Highway Act 1956 and roads provisionally named as National Highways were declared statutorily as National Highways.

### **3 Second Road Development Plan—1961-1981 (Bombay Plan)**

**3.1** Even though targets of Nagpur Plan were significantly achieved by 1961, the road system remained deficient and inadequate to meet the country’s transport demand. The changed economic, industrial and agricultural scenario of newly independent country justified a review of road requirements. The second attempt for preparing Road Development Plan on all India basis was started in 1958 and Chief Engineers of various States adopted a 20 year Road Development Plan (1961-81) popularly known as Bombay Plan.

**3.2** In Bombay Plan, the connectivity targets were further raised. It envisaged that no village should be more than 1.5 miles from any road in developed agricultural areas, 3 miles from any road in semi-developed areas and 5 miles from any road in

under-developed areas. The Bombay Plan framed a scheme of priorities which included among others, provision of missing bridges, improvement of road surface to at least single lane black topped specification for National and State Highways, widening of main roads in vicinity of large towns to two-lanes or more and provision of two-lane roads on major arterial routes. The overall objective of Bombay Plan was to raise density of road mileage from 26 to 52 miles per 100 sq.miles of area. This target was set, taking into account level of expected development and needs of rural and urban areas.

#### **4 Third Road Development Plan—1981-2001 (Lucknow Plan)**

**4.1** The decades of 1980's and 1990's saw fast growth in road transport, with introduction of contemporary heavy and light vehicles, having features and specifications, matching with the best anywhere in the world. As a departure from the earlier linear approach, Lucknow Plan was evolved on the basis of the Research Programme. This plan not only addressed to the revised connectivity targets but also included targets pertaining to highway construction and maintenance technology as also materials. Salient features of this plan were as follows: -

- i) New forms of energy were introduced, which include alcohol-petrol mixtures, LPG and liquid fuel from coal.
- ii) Alternative binders considered which include lime-fly ash-concrete, lean cement concrete, soil-lime, coal tar, tar-bitumen blends, etc.
- iii) Highway maintenance and design study was initiated by the then Ministry of Road Transport & Highways. This in turn led to World Bank HDM-III Model.
- iv) Geometric design standards were improved.
- v) Data on traffic flows, commodity movement, and passenger travel was considered essential for road planning.
- vi) Economic evaluation in the rural road schemes was emphasized. Parameters such as increase in agricultural produce; marketability of perishable items, education, health etc., were considered.
- vii) Latest instruments, like radar, speed meters, vehicle mounted skid resistance meters etc., were given cognizance.
- viii) Growing importance of research to obtain optimal solutions to planning, design and construction was recognized.
- ix) It was recommended that adequate funds should be earmarked.

**4.2** Lucknow Plan covered following requirements as governing criteria for the road network planning and development.

- i) Social infrastructure to connect rural, hilly, tribal and backward areas with administrative, market, health and educational centres
- ii) Security and Strategic requirements were considered.
- iii) Need for effecting fuel economy through provision of good roads, better maintenance and bypasses to avoid congested areas was emphasized.
- iv) Requirements for non-mechanized traffic in urban areas were considered.

**4.3** This Plan also provided directions for State Governments to prepare their own perspective plans for road development, keeping in view differences in land use pattern, population, terrain, potential for economic development and social infrastructure needs to achieve a balanced road network.

## **5 Economic Reforms**

**5.1** Economic reforms introduced in the country during Eighties led to enhancement of capital flow into highway sector with bigger size project packages which led to international lending agencies like World Bank, Asian Development Bank, OECF and JBIC stepping in to provide loan assistance for road projects. The entry of private sector was facilitated by liberalized economic policies of the Government. These were defining moments in the growth of highway sector and contracting industry.

**5.2** State PWDs were having the responsibility of construction of roads including the National Highways in respective States. These State PWDs were not exposed to the contemporary state of art in construction methodology, plants and equipments, techniques etc. Therefore, it was considered prudent to take measures, which would be of contemporary nature and akin to the best anywhere in the world. This led to certain changes in the institutional arrangements for execution of highway projects as follows:

- i) Engagement of consultants for project preparation and construction supervision,
- ii) Packaging of large size road contracts,
- iii) Entry of foreign contractors, and



- iv) Introduction of state of art road construction technology, contemporary plants and equipments, and increased mechanization in construction.

**5.3** In 1988, the National Highways Authority of India was constituted for execution of works on National Highways to provide the link between metros and enhance overall connectivity of the country.

## **6 Fourth Road Development Plan—2001- 2021 (Road Development Plan Vision: 2021)**

**6.1** In 2001, the Indian Roads Congress, at the behest of the Ministry of Road Transport & Highways, prepared the “Road Development Plan Vision: 2021”. This Plan laid emphasis on the necessity of coordinated approach to develop an Integrated Transport Policy with optimal inter-modal mix. Besides, emphasis was also laid on safety, energy efficiency and conservation, environment protection, self-sustaining and viable transport units. The document recognized development of road infrastructure as the key element to promote tourism, provide access to mining areas, power plants, ports etc.

**6.2** In the document the major issues of concern are as follows.

- i) Inadequate budgetary allocations for the Road Sector, and the need for mobilization of resources including toll financing and private sector participation,
- ii) Increasing traffic volumes on main corridors requiring capacity augmentation (Expressways, 4-laning/6-laning with service lanes),
- iii) Strengthening of pavement to cope with movement of heavy commercial vehicles particularly on National Highways and State Highways.
- iv) Back-log of village accessibility, inspite of an impressive road network length, thus pointing to the need for preparing Master Plans at district level and undertaking massive programme of construction of Village Roads in accordance with such plans.
- vi) Preservation of existing road assets, improving riding quality to provide better level-of-service to road users.
- vii) Improving capacity of roads and other traffic management measures in urban areas.
- viii) Capacity building in the highway departments, consultancy sector and construction industry for efficient implementation of the development programme.

- ix) Promoting Research & Development activities.
- x) Incidence management and provision of wayside amenities on main roads to improve level-of-service to road users.
- xi) Improving energy efficiency, road safety and mitigating adverse environmental impact.

**6.3** The major recommendations of Road Development Plan Vision: 2021 are summarized as under:

- i) Development of 10,000 km Expressways by the year 2021 for unhindered and high speed movement of traffic, considering that many of the National Highway corridors where 4-laning was done would get saturated in 5 to 10 years time.
- ii) Four/Six laning of 16,000 km of National Highways in the first decade covering mostly the NHDP and other essential segments and another 19,000 km in the second decade.
- iii) Accelerated efforts for bringing the entire National Highway network to minimum 2-lane standards which would be tackled in two parts, (i) Upgrading existing sub-standard two lanes to proper two lane standards including strengthening of weak pavements, reconstruction /rehabilitation of weak or damaged bridges, hard shoulders and spot improvements in accident prone locations. The proposed targets being 20,000 km in the first decade and 24,000 km in the second decade. (ii) Widening single lane to two lanes by assigning priority to routes identified under Asian Highway Network and such other routes linking the adjoining countries and important rail heads, inland container depots, container freight stations etc. The proposed targets for this being 15,000 km in the first decade and 7,000 km in the second decade.
- iv) Planning of bypasses for the NH network in the form of peripheral expressways to interlink the highways radiating from the cities having population of more than 1 million.
- v) Replacement of all existing railway level crossings on National Highways with road over/under bridges in a phased manner depending upon the traffic and number of gate closures.



- vi) The importance of pavement management system (PMS) and bridge management system (BMS) for assessment of maintenance needs of highways and various financing options for maintenance of highways, e.g. introduction of road user tariff to provide dedicated funds for maintenance and deposition of the proceeds there from in an autonomous road fund, establishment of board of management to administer the road fund, creation of an autonomous highway authority administered by a board for organization and management of the road network, increase in private investments for maintenance, contract maintenance.
- vii) Provision of proper wayside amenities as an integral part of the highway network.
- viii) Expansion of the National Highway Network to a total length of 80,000 km.
- ix) Provision of funds for maintenance and repair of National Highways as per the actual requirements.
- x) Four-laning of about 3,000 km of State Highways in the first decade and another 7,000 km in the second decade.
- xi) Two-laning of State Highways including strengthening and widening of bridges and culverts for 35,000 km in the first decade and 60,000 km in the second decade.
- xii) Expansion of the secondary road system so as to have overall length of 1,60,000 km of State Highways and 3,20,000 km of Major District Roads.
- xiii) The targets for providing basic access of villages proposed were as follows:
 

a)	Villages with population above 1000	Year 2003
b)	Villages with population 500-1000	Year 2007
c)	Village with population below 500	Year 2010
- xiv) Necessity to develop the urban infrastructure, such as urban expressways, ring roads bypasses and flyovers, truck terminals and transport nagars, bus terminals, bus-ways, cycle tracks, adequate drainage system and application of Intelligent Transport System (ITS).

**6.4** This Plan further expands the horizon of previous development plans after making an objective assessment of likely future development in highway sector in the all conceivable areas like investment policies, government policies, highway planning and management, construction technologies, new highway materials, development of new highway project procurement and execution instruments, traffic and transportation and safety & environment etc. The document reflecting the urgent need for the high speed connectivity identified corridors of expressway apart from upgrading the existing network of national highways and other lower hierarchy roads. Maintenance of highway assets is given due recognition by assigning importance to PMS and BMS to work out assessment of maintenance needs of highways and a strategy to finance maintenance works. Provision of way side amenities is also brought within the overall network development. Document also mentions about the importance of corridor management involving land management, tackling of safety hazards and traffic bottlenecks, control on overloading of vehicles, incidence management, pavement riding quality. For this purpose, the document recommended promulgation of comprehensive legislation by the Centre and the States for efficient land and traffic management including effective control on ribbon development and encroachments. Setting up of a single Highway Authority was also recommended for not only construction and maintenance of roads /bridges but also for management of road land and traffic.

**6.5** The document also provides for preparation of long term plan covering following aspects:

- i) For R&D in the highway sector, it is necessary to identify the thrust areas which hold potential for application under Indian conditions. Proper dissemination of research findings and demonstration projects have been recommended to overcome the reluctance on the part of the highway engineers to adopt new techniques.
- ii) Focus has been drawn regarding the importance of strategies for mobilization of funds by tapping all possible sources, viz. Public, Private and Foreign and proper management of dedicated highway development plan (i.e. from levy of cess on petrol and high speed diesel) including devising of clear rules for allocation and accountability and proper monitoring system.
- iii) It is necessary to give importance on the aspect of capacity building and human resource development in the sector including development of construction technology, implementation of quality systems, environment preservation, highway safety and energy conservation.

## 7 Rural Road Development Plan Vision: 2025

**7.1** The Ministry of Rural Development, Government of India brought out this document in May 2007, in the background of Pradhan Mantri Gram Sadak Yojana (PMGSY), which was launched in December 2000. Major issues concerning capacity Building, Research & Development, Human Resource Development (HRD) and Human Resource Management (HRM) covered in the document, are as follows:

- i) Quality Assurances safeguards should be inbuilt at every stage of the project cycle viz. surveys, investigations, designs, bidding documents, construction and maintenance.
- ii) States may consider instituting system of technical audit with a view to propose corrective measures for future projects. The NRRDA may lay-down the audit procedures.
- iii) It is necessary to sensitize the communities and users of rural roads to road safety concerns and role, they can play in reducing the accident burden.
- iv) The road agencies must recognize the potential environment concerns and comply with the provisions of Environment (Protection) Act and Environment (Conservation) Act.
- v) The NRRDA may take lead in introducing a Rural Road Management Act, which should, (a) define powers, functions and obligations of the road authority, (b) requires a register of all public roads and (c) govern regulations of rural roads and require instituting an asset management system.
- vi) The PMGSY programme seeks to integrate 'development' and 'employment' objectives. The current employment potential is estimated to be around 460 million man-days per year and rise to over 950 million man days by the 13<sup>th</sup> Five Year Plan (2017-2022).
- vii) The Government should fund capacity building of District Panchayat to enable them to take over functions like construction, maintenance, maintenance management and road safety.
- viii) There is a need for concentrated Research and Development efforts for evolving most suitable and economical designs and appropriate technologies.

- ix) Further increase in absorption capacity will only come through institutional enhancements. There is a need for a single specialized nodal agency in each State which should be responsible for overall policy, planning and management of rural roads.
- x) It is necessary to create specialized rural road division so as to ensure necessary technical expertise and management quality. A single cadre is necessary.
- xi) There is a need for District level consultants in addition to State level and National level consultants.
- xii) Every State should setup a training centre for roads including rural road. The NITHE should perform and take leading role at national level and the example of National Academy of Construction at Hyderabad is worth replicating by other States. Training Institutes should collaborate with international agencies like ILO, T&B and IFG.
- xiii) Government need to develop independent think tanks and academicians on various aspects of rural roads like engineering, safety, environmental issues, socio-economic impact etc. They may also fund institutions like NCAER, IIPA, IIMs, IITs and NIITs. Eminent persons in the field should get institutional support and Ministry of Rural Development may provide lead role.

## **8 Expanding Horizon of Highways Sector**

**8.1** The scope and extent of highway sector in the last seven decades have expanded from providing a given target connectivity level of roads to the population centres to a complex gamut of schemes covering social, economical, ecological & environmental issues apart from the engineering and technology issues concerning the highway sector. It is necessary that status of highways sector in our country is reviewed to ascertain and workout strategies for future.

**8.2** In order to develop highways sector according to necessity of time, role of different organizations involved in strategic decision making and those engaged directly for development and support of highways sector is required to be reviewed, to ascertain necessity of human resources development.



## CHAPTER 2

# ROAD HIERARCHY SYSTEM

## 1 Introduction

**1.1** Ever since road development plans were initiated, major emphasis of all such plans have been to enhance and augment the road density in the country by setting higher and higher targets for road connectivity. In the First Plan the target was set for creating a density of 26 miles of road per 100 sq. miles of area which was increased to 52 miles of road per 100 sq. miles of area in the Second Plan. In Fourth Road Development Plan, all villages of the country are targeted to be connected by 2010. For identifying and monitoring these connectivity targets, a road hierarchy system was conceptualized in the First Road Development Plan which still continues for the purpose of identification of any road.

**1.2** According to this system roads are divided into five categories i.e. (i) National Highways, (ii) State Highways, (iii) Major District Roads, (iv) Other District Roads and (v) Village Roads. In this classification, National Highways, State Highways and Major District Roads constitute 'Main Roads', whereas Other District Roads and Village Roads constitute 'Rural Roads'. With the passage of time other road categories like 'urban road', peripheral expressways 'express ways' were added for the purpose of creating distinct identification based on their functionality. Strategy for setting the road connectivity targets under different road development plans, however more or less were based on the above mentioned hierarchy system of road network. Roads and highways as physical entity running through length and breadth of the country can be described under their order of hierarchy in following paras:

## 2 Expressways

**2.1** Fourth road development plan initiated in the year 2001 introduced Expressways as distinct category. This plan envisaged development of 10,000 km Expressways by the year 2021 for unhindered and high speed movement of traffic, considering that many of the National Highway corridors would get saturated with passage of time.

## 3 National Highways

**3.1** The National Highways have grown from 21440 kms in 1947 to 66590 kms in 2006, i.e. by the end of Tenth Plan period. The National Highways comprise only

2 percent of total length of roads, but carries over 40 percent of the total traffic across the length and breadth of the country. The development and maintenance of National Highways are implemented on Governments and Union Territories agency basis. The PWDs of States, the National Highways Authority of India (NHAI) and Border Road Organization (BRO) are the main implementation agencies.

**3.2** During recent past, 43,705 km of National Highways were entrusted to the States Governments/Union Territories for the stretches passing through respective States. The NHAI was entrusted with 16,117 km of National Highway included in various phases of National Highway Development Project (NHDP) and other important National Highways. 5,512 km of National Highways in difficult border areas were given to Border Roads Organization.

## **4 State Highways and Major District Roads**

**4.1** State Highways (SHs) and Major District Roads (MDRs) constitute the secondary system of road transportation in the country. The SHs provide linkages with the National Highways, district headquarters of the State and important towns, tourist centres and minor ports. Their total length stands at about 1,28,000 km. Major District Roads run within the district connecting areas of production with markets, connecting the rural areas to the district headquarters and to State Highways and National Highways. Their length is about 4,70,000 km. These roads also carry medium to heavy traffic. It is assessed that this secondary system of roads carries about 40 percent of the total road traffic, although they constitute only about 13 percent of the total road length. They are major carriers of road traffic within the states and some interstate traffic. Besides, by serving as linkages between the rural and urban areas, the State Highways and Major District Roads contribute significantly to the rural economy as also to the industrial development of the country by enabling movement of industrial raw materials and products from and to the interior of the country.

**4.2** Though the size of the network comprising SHs and MDRs is very good, the quality of roads is not, as per the standards set for these categories of roads. Their present condition and stage of development varies widely from State to State. The status of MDRs is particularly very bad. The main reason for this state of affairs is that the funds for the development of this secondary system are inadequate. While reasonable funds have been made available for the National Highways and the Rural Roads, somehow the secondary system of roads is not receiving the desired attention in the matter of financial allocations in relation to requirements. The result is that there are several deficiencies in the existing SHs and MDRs such as, (i) inadequate width of carriageway in relation to traffic demand (ii) Weak pavement and bridges,

(iii) Congested stretches passing through cities/towns, (iv) Poor safety features and road geometrics and inadequate formation width in hilly and mountainous region, (v) Missing links and bridges and (vi) Several railway level crossings to be replaced with ROB/RUBs.

**4.3** The existing road network is under severe strain due to traffic growth, overloading of vehicles and inadequacy of funds for road maintenance. A broad assessment shows that over 50 percent of SHs and MDRs network has poor riding quality. Losses due to poor condition of these roads would be around Rs. 6000 crore per annum. Besides, their premature failure results in huge rehabilitation and reconstruction costs implying infusion of avoidable plan funds at accelerated intervals.

## **5 Other District Roads and Village Roads**

**5.1** India has essentially a rural oriented economy with 74 percent of its population living in its villages. In the year 2000, it was estimated that about 330,000 out of its 825,000 villages and habitations were without any all-weather road access. This affected the quality of life of the people living in villages. The road connectivity is a key component of rural development by promoting access to economic and social services and thereby generating increased agricultural income and productive employment opportunities. A major thrust for development of rural road (which covered Village Roads) was given at the beginning of Fifth Five Year Plan in 1974, when it was made a part of Minimum Needs Programme (MNP). In 1996, MNP merged with Basic Minimum Services (BMS) programme. The development of Village Roads did not receive any significant impetus upto the year 2000. The implementation mechanism to achieve the targets of village population connectivity as envisaged in the Fourth Road Development Plan is largely through the Central Government scheme launched in the year 2000, popularly known as Pradhan Mantri Gram Sadak Yojana (PMGSY). This scheme was launched with full funding from Central Government. The Rural Roads included under PMGSY cover both Other District Roads (ODR) and Village Roads (VR). The ODRs serve the rural areas of production and providing them with outlet to market centres, blocks, tehsil and main roads. The VRs connect villages and group of villages with each other or to market centres and with nearest road of higher category. PMGSY envisages development of all weather roads, which are negotiable during all seasons with some permitted interruptions, i.e. cross drainage structures in which duration of overflow or interruptions shall not exceed 12 hours for ODRs and 24 hours for VRs.

**5.2** Rural road network required for providing 'basic access' to all villages is termed as Core Network. Basic access is defined as one all weather road access from each village to nearby market. It comprises of 'Through Routes' and 'Link Routes'.



The through routes are the ones, which collect traffic from several link roads and lead it to market centres, District Road or State Highway or National Highway. The link routes are the roads connecting a single habitation to through roads. The spirit and objective of PMGSY is to provide good all weather road connectivity to unconnected habitations in rural areas. Provision of new connectivity is given priority compared to upgradation works.

## **6 Other Roads**

The Other Roads, which have significance in their own way in providing connectivity to important locations and also for facilitating access to adjoining areas etc., are Forest Roads, Roads in Border Areas, Roads providing connectivity to dams /reservoirs and power stations (especially hydro-power stations), roads connecting dedicated areas such as Special Economic Zones (SEZ), etc. The financing of such roads are made under different schemes of the Central Govt. and the State Govt. The responsibility of development and maintenance of these roads are vested with the concerned authorities in the Central and the State Govts.

## **7 Increasing Roles of Roads**

For modern society, the transportation system plays very important role for day to day living. In the present as well as likely future scenario, country's development is going to witness rapid growth of urban centres providing job opportunities and thereby creating more intensive flux of movement of human as well as goods and services between urban centres and rural hinterland. Road network, despite development of alternative modes of transport, will continue to remain dominant mode of transportation. Road sector will continue to remain hub of advanced technology application in the area of construction, maintenance and management of transport network development. Ever growing complexity of road sector coupled with high magnitude of investment have brought in several players involved in its development and maintenance, presenting a true amalgamation of human & technology management.



## CHAPTER 3

# ADVANCEMENTS IN ROAD SECTOR

## 1 Society and Roads

From the earliest pre-historic pathways used by nomads as formed by the continuous trampling of earth by the pasture animals like horses and mules to modern highways criss-crossing the landscape of the country roads have travelled a long distance in time and space continuum. Roads are exceptional in their mutability and their longevity in that where as the artifacts of ancient time are survived through archeological efforts, but people continue to use roads built many centuries ago. Complete life demands movement as testified by constant and timeless movements of traders, astrologers, geographers, merchants, sailors and soldiers since time immemorial. As roads outlast people and conditions that created them and vehicles that traversed over them, they are central element in social infrastructure. They are endowed with great simplicity and amazing complexity. Roads lead to freedom of movement and in that sense they are key to economic prosperity. Mobility also creates equality and therefore roads have also acted as a powerful medium to counter the power of monopoly in the human history. Development of early pathways to modern highways also shows a direct interplay and correlation between social & technological change taking place in the country and the development of highways. The density of roads and highways network, their upkeep and riding quality bears close connection to the country's economic prosperity, social stability and cultural integration.

## 2 Prime Mover of Development

**2.1** Roads in its earliest versions were mainly providing small rural connectivity joining neighbourhood areas of settlements and productivity, more or less following natural contours. With the growth of human settlement on a more structured footing when they became a part of some kind of political system, roads became derivatives of combination of productivity, social security and accessibility criteria. Development of road network was governed by political ambitions to bring more and more productivity centers under political suzerainty. In course of time, they developed into economic arteries providing speedier connectivity not only between two points but also generating its own area of influence all along its traverse, creating potential of developing them into population and productivity centers depending upon other sustainability factors like water, energy, soil and climatic conditions.

**2.2** In modern times roads are no longer a development derivative but have become a prime mover in deciding the contours of development which the policy planners would like to put in place. They have pervasive effect on social, economic, energy, environmental and land-use issues and their development is guided by ease of mobility & accessibility, livability and sustainability. Highway projects being highly capital intensive with long gestation period and low rate of returns, have largely remained within the domain of government funding. Government, therefore is the largest and biggest stakeholder in the planning, designing and implementation of highway projects.

**2.3** With the enormous growth of highway network the complexity of network development have grown phenomenally from the earlier simple public exchequer funding and execution of work to the present multitudinous and multifarious aspects involving government policies concerning land acquisition, environment, ecology; investment policies for bridging the gap between demand placed by the highway sector and resource availability; highway planning covering road network planning, road side amenities planning, information system development; construction technologies with emphasis on low carbon foot print technology development; new highway materials, specifications and code of practice; new execution instruments in the light of emergence of international players in financing and execution of projects; traffic and transportation system, parking management, multi modal system; and safety and environment involving road side aesthetics, traffic canalization, highway landscaping, road safety, pedestrian facilities, noise and pollution etc.

### **3 Wider Decision Support System**

**3.1** Development of technology along the course of human development is most directly reflected in creating accessibility to the areas which were earlier beyond easy reach of mankind. Technology as a harbinger of development when put in use to serve mankind by taming the nature, the earlier paths and ways following natural contours were replaced by roads duly stabilized cutting into the natural landscape, altering, modifying, even destroying existing flora and fauna. The negative impact on ecology is however, more than offset by the rewards in terms of enhanced accessibility and associated fruits like economic development, social, political and ethnic integration of the country as a whole. The task of providing stable surface with minimum intrusion in the ecological setup calls for the application of professional services of planners, scientists, engineers, technologists, and highway managers. The complexity of task in hand requires planners and administrators of Central and State Governments and other professional groups, think tank and individuals to provide decision support system on the policy planning.

**3.2** Scientists in the field of soil science, hydrology, ecology, environment, structural engineering are engaged for developing science and technology to help provide solution to the real time field problems as also to develop best suited methodology in the construction and maintenance field which is both economical and ecologically least intrusive. Engineers, consultants and contractors, are required to translate science and technology into physical entity in the shape of roads and highway network as per the decided standards and specifications. The services of Quality Assurance experts are called for ensuring that investment done in creating and maintaining capital asset is resulting into output consistent with the laid down procedures, prescriptions and standards to meet intended results. Speed of execution of work with ever growing challenges with enhanced quality and safety standards calls for introduction of new machineries with higher productivity and reduced direct human labour component. This calls for contribution of machinery and equipment, their operators, manufacturers and technologists.

#### **4 Quality Standards and Laboratory Testing**

With the shifting emphasis of Government from the role of a 'provider' to 'enabler and facilitator' more and more numbers of Mega projects will be seen coming up in the country. All such projects require proper testing of materials which is a pre-requisite for attaining high quality of the work. This requires specialized material and product tests covering physical, chemical, ultrasonic, x-ray and various other types of tests which can not possibly be carried out in a site laboratory without adding high-costs on the project. Product and material testing are not only required for the purpose of obtaining final product of specified service standards, but also for the product and material development to support quality control, evaluation, research, development, trouble shooting and many other client organization's need. These tests also require trained professionals, specialized in conducting the tests and interpreting the results. Therefore, the need arises for utilization of independent laboratories with facilities to conduct the tests as per IRC specifications and in controlled atmospheric conditions like temperature, humidity etc.

#### **5 Regulatory Agencies**

As highways are not only intrusive but also modifier of country's landscape, contours and ecological set up, planning for the mitigation of adverse impact calls for expertise in the form of various regulatory agencies, bodies for assessing, assisting and if required, correcting, modulating and modifying the highways planning, execution and management by playing regulatory role. Such regulatory role is also performed by bodies like Development Authorities, Municipal Corporations who are mandated to



design, conceive and implement various control rules to ensure that the development of areas under their control takes place in accordance with the character they would like to impart to their city/township in terms of infrastructure development. Regulation being legalistic in its concept, demands equipping the highway planners, engineers and managers with the legal aspect of highway related activities.

## **6 Maintenance Management**

Modern highways unlike their ancestors are highly capital intensive proposition in which money's worth not only calls for the best option in terms of technology applications with minimum adverse fall out but also calls for maximum preservation of asset created with timely and well directed infusion of maintenance care. Such maintenance if imparted with great attention, care and sense of alacrity will translate into maximization of economy in highways life cycle cost. Any delay in the maintenance may lead to highways condition beyond economic repair causing avoidable expenditure. Research bodies and engineers are required to provide expertise using technologies, innovation, mechanization supported by responsive organization in creating and implementing effective maintenance management system. Highway construction being highly capital intensive activity, financing the same is no longer in the public sector domain. Concept of self financing of construction has given rise to many innovative contract management instruments like BOT, BOOT etc. under PPP mode. Coupling of revenue generating capacity with construction and maintenance of highways with high level of user satisfaction in terms of riding quality and way side amenities have created professional fields in revenue related aspect of highway construction like toll management, landscape management, highway petrol for quick shifting of accidented vehicle and transfer of patient to hospital.

## **7 Training and Development**

**7.1** One of the major area of concern highlighted in the 'Road Development Plan Vision: 2021' is relating to capacity building in the highway departments, Consultancy Sector and Construction Industry for efficient implementation of the development programme. With ever increasing interaction and mutual dependence of various stakeholders viz. Road Agencies, Contractors and Consultants etc. for the service and product delivery, there is all-round need to enhance, develop and up-date the skills not only in technical designs but also in project management, financial aspects, legal issues, social and environmental aspects. There is shortage of skilled staff at all levels including skilled labour, equipment operators, and supervisors, engineers with the government, contractors and consultants. Exposure to international scenario and expectation of world standard products from the highway agencies have made

the highway sector more demanding on its professionals. The jump in the project size has further added to the complexities of tasks involved. The road agencies dealing with the roads are facing the challenge of rational planning, project identification and development, efficient and transparent contract procurement, administration, operation, and management of roads to provide good quality of service to road users. Declared emphasis on the execution of project through BOT, DBFO route in the fourth road development plan, require re-orientation of highway engineers who were groomed in the earlier government contract procurement system. The contractors are facing difficulties in getting skilled workers, equipment operators and quality construction managers. Consultants are also facing shortage of experienced and skilled personnel for design and engineering for undertaking feasibility studies and preparation of DPRs and for supervision of projects during construction.

**7.2** Thus so many players involved in the Highway sector, some directly some in contributory, peripheral and other capacity are expected to discharge the functions as assigned to them in a manner consistent with the performance standards as set out for the designated job. In other words, there should not be any performance related gap. Information, knowledge and skills of many varied field of management, operation, maintenance as generated by the research bodies, experts and professionals is required to be transferred to relevant groups and individuals and is to be ensured that such knowledge, skills and abilities are adequately received, assimilated and acted upon by the recipients in their job deliverance. It is essential to widen, enlarge and enrich the base of skills of highway professionals so that they become capable of responding to new challenges in effective and confident manner. T&D for the highway professionals is therefore central to highway sector development.

## **8 Role Played by Different Organizations**

Dynamics of highway sector played out by core sector organizations with professionals engaged in (a) Highway planning and design (b) Pavement engineering and pavement material (c) Geotechnical engineering (d) Bridge engineering and (e) Traffic and transportation as also other complementary, regulatory and support organizations should be fully understood to enable one to grasp the complexity and inter relationship among these organizations for developing a structured T&D format for their capacity building through skills, knowledge and ability enhancement.

## CHAPTER 4

### CORE ORGANIZATIONS

#### 1 Core Organizations

**1.1** The Highway development programs are implemented through a number of Government and Semi-Government organizations. These organizations are responsible for preparation of estimates, getting the estimates approved from the funding agencies, processing for deciding consultancy and contracting agencies and thereafter, ensuring implementation of road development projects. Some of these agencies work exclusively for roads, whereas, other agencies deal with buildings and roads. These core organizations are, in fact, central to any road asset management system and function within more or less a defined and structured procedure directed in a functionally integrated manner aimed at ensuring desired level of service delivery. These organizations/groups/bodies may be in the field of research like CRRI or contract management like NHAI or even in the field of training like NITHE but one thing common in them is that they are all integrally and directly linked serving the final objective of creation, management and maintenance of highway system at the desired level of service delivery.

#### 2 Planning Commission of India

**2.1** The Planning Commission was set up by a Resolution of the Government of India in March 1950 in pursuance of declared objectives of the Government to promote a rapid rise in the standard of living of the people by efficient exploitation of the resources of the country, increasing production and offering opportunities to all for employment in the service of the community. The Planning Commission was charged with the responsibility of making assessment of all resources of the country, augmenting deficient resources, formulating Plans of the most effective and balanced utilization of resources and determining priorities. For the first eight Plans (i.e. from 1951 to 1997 including interim Annual Plans between 1966 and 1969, and between 1990-91 and 1991-92) the emphasis was on a growing public sector with massive investments in basic and heavy industries. Since the launch of the Ninth Plan in 1997 however, the emphasis on the public sector has become less pronounced and the current thinking on planning in the country, in general, is that it should increasingly be of an indicative nature.

**2.2** The Prime Minister is the Chairman of the Planning Commission, which works under the overall guidance of the National Development Council. The Deputy



Chairman and the full time Members of the Commission, as a composite body, provide advice and guidance to the subject Divisions for the formulation of Five Year Plans, Annual Plans, State Plans, Monitoring Plan Programmes, Projects and Schemes. The 1950 resolution setting up the Planning Commission outlined its functions as follows.

- i) Make an assessment of the material, capital and human resources of the country, including technical personnel, and investigate the possibilities of augmenting such of these resources as are found to be deficient in relation to the nation's requirement;
- ii) Formulate a Plan for the most effective and balanced utilization of country's resources;
- iii) On a determination of priorities, define the stages in which the Plan should be carried out and propose the allocation of resources for the due completion of each state;
- iv) Indicate the factors which are tending to retard economic development, and determine the conditions which, in view of the current social and political situation, should be established for the successful execution of the Plan;
- v) Determine the nature of the machinery which will be necessary for securing the successful implementation of each stage of the Plan in all its aspects;
- vi) Appraise from time to time the progress achieved in the execution of each stage of the Plan and recommend the adjustments of policy and measures that such appraisal may show to be necessary; and
- vii) Make such interim or ancillary recommendations as appear to it to be appropriate either for facilitating the discharge of the duties assigned to it, or on a consideration of prevailing economic conditions, current policies, measures and development programmes or on an examination of such specific problems as may be referred to it for advice by Central or State Governments.

**2.3** Planning Commission plays an integrative role in the development of a holistic approach to the policy formulation in critical areas of human and economic development including the highways infrastructure. With the emergency of severe constraints on available budgetary resources, the resource allocation system between the States and Ministries of the Central Government is under strain. This requires the

Planning Commission to play a mediatory and facilitating role, keeping in view the best interest of all concerned. It has to ensure smooth management of the change and help in creating a culture of high productivity and efficiency in the Government. The key to efficient utilization of resources lies in the creation of appropriate self-managed organization at all levels. In this area, Planning Commission attempts to play a systems change role and provide consultancy within the Government for developing better systems. In order to spread the gains of experience more widely, Planning Commission also plays an information dissemination role.

### **3 Ministry of Shipping, Road Transport and Highways**

**3.1** The Governments at the Central and the State levels are responsible for development and maintenance of highway network in the country. Whereas the Central Government is primarily responsible for development and maintenance of National Highway Network in the country, the State Governments and the Union Territories are responsible for the development and maintenance of various categories of State Roads. The Right-of-Way (ROW), i.e. the land acquired for the highways, is accordingly vested with the concerned Governments at the Central and State levels. However, besides being responsible for financing of the development and maintenance of National Highway Network in the country, the Central Government also provides funds for the State Roads under various schemes. Therefore, the financing of Highway projects and maintenance of existing highways is by and large from Government funds both under Plan and Non-Plan. New ways of funding by cess and through public private participation are also being followed for Highway projects. Thus planning, funding and execution of Highway projects, is by and large responsibility of the Central and the State Governments. Centre Government deals with Highways sector at planning, budgeting and funding level. This role is performed by Ministry of Shipping, Road Transport and Highways, Department of Rural Development under the Ministry of Rural Development and the National Rural Roads Development Agency (NRRDA) under the Ministry of Rural Development.

**3.2** The National Highways came into being on 1.4.1947 when the Government of India assumed responsibility for the development and maintenance of certain roads provisionally known as National Highways. In 1956, the Govt. of India enacted the National Highway Act 1956, and the then existing National Highways were declared statutorily as National Highways. In the process of implementation of the various recommendations of the Nagpur Plan and as a result of the Central Government assuming complete financial responsibility for the maintenance and development of a system of roads accepted by them as National Highways, the Office of the Consulting



Engineer (Road Development) to the Government of India was expanded and came to be known as the Roads Wing of the Ministry of Shipping and Transport. In 1966, the head of the Organisation was designated as the Director General (Road Development) and Additional Secretary to the Government of India, and the post was upgraded to Special Secretary. The erstwhile Ministry of Shipping and Transport is presently called Ministry of Shipping, Road Transport and Highways.

**3.3** The Department of Road Transport and Highways of this Ministry came into being during 1999-2000, and it has two wings, viz. the Roads Wing and the Road Transport Wing. The Roads Wing is concerned mainly with matters relating to Highways and performs following functions:

- i) Advising Govt. on all general policy matters relating to Highways;
- ii) Development and maintenance of roads declared as National Highways;
- iii) Administration of the Central Road Fund and allocate it equitably to the various States/UTs for works approved by the Government of India pertaining to State Roads other than Rural Roads;
- iv) Provide funds for selected State roads including bridges on inter-State or roads of economic importance;
- v) Securing balanced development of roads and road transport and to co-ordinate with other systems of transport, principally railways;
- vi) Development/updating of Specifications and Standards for Roads and Bridges;
- vii) Research on Roads.
- viii) Improve the technical knowledge and experience of the highway engineering personnel by sponsoring the training of engineers in India and abroad.
- ix) Disseminating information on standards and modern engineering techniques, and by encouraging the study of road economics and administration;
- x) Advise other Central Government Ministries (Defence, External Affairs, etc.) on all matters concerning roads and to advise similarly the State Governments;

- xi) Function generally as a repository of technical, statistical and administrative information on all matters concerning roads and bridges.

**3.4** Roads Wing performs its above mentioned functions governed, directed and assisted by the following Acts, Rules and Regulations:

- i) The National Highways Act, 1956;
- ii) The National Highways (Temporary Bridges) Rules, 1964;
- iii) The National Highways Authority of India Act, 1988;
- iv) The National Highways (Collection of fees by any Person for the Use of Section of National Highways/Permanent Bridge/Temporary Bridge on National Highways) Rules, 1997;
- v) The National Highways (Rate of fee) Rules, 1997;
- vi) The National Highways (Fees for the use of National Highways section and Permanent Bridge - Public Funded Project) Rules, 1997;
- vii) The National Highways (Manner of Depositing the amount by the Central Govt. with the Competent Authority for Acquisition of land) Rules, 1998;
- viii) The Central Road Fund Act, 2000;
- ix) The Control of National Highways (Land & Traffic) Act, 2002;
- x) The National Highways Tribunal (Procedure) Rules, 2003;
- xi) The National Highways Tribunal (Procedure for appointment as Presiding officer of the Tribunal) Rules, 2003;
- xii) The National Highways Tribunal (Procedure for investigation of misbehavior or incapacity of Presiding Officer) Rules, 2003;
- xiii) The National Highways Tribunal (Financial and Administrative Powers) Rules, 2004;
- xiv) The National Highways Tribunal (Salaries, Allowances and other Terms and Conditions of service of Presiding Officer) Rules, 2005;
- xv) The National Highways Tribunal (Salaries, Allowances and other Terms and Conditions of service of the Officers and employees) Rules, 2005;

- xvi) Guidelines for formulation of State Sector Road Development Programme under Central Road Fund;
- xvii) Guidelines for Centrally Sponsored Schemes of State Roads of Inter-State Connectivity and Economic Importance;
- xviii) National Highways Administration Rules, 2004;
- (xix) Standard Bidding Documents - published by the Indian Roads Congress;
- xx) Compendium/Specifications published by the Indian Roads Congress.

#### **4 Department of Rural Development, Ministry of Rural Development**

**4.1** In October 1974, the Department of Rural Development came into existence as a part of Ministry of Food and Agriculture. In August 1979, the Department of Rural Development was elevated to the status of a new Ministry of Rural Reconstruction. In January 1982, the Ministry was renamed as Ministry of Rural Development. In January 1985, the Ministry of Rural Development was again converted into a Department under the Ministry of Agriculture and Rural Development which was later rechristened as Ministry of Agriculture in September 1985. In July 1991 the Department was upgraded as Ministry of Rural Development. Another Department viz. Department of Wasteland Development was created under this Ministry in July 1992. In March 1995, the Ministry was renamed as the Ministry of Rural Areas and Employment with three departments namely, Department of Rural Employment and Poverty Alleviation, Rural Development and Wasteland Development.

**4.2** Again, in 1999 Ministry of Rural Areas and Employment was renamed as Ministry of Rural Development. This Ministry has been acting as a catalyst effecting the change in rural areas through the implementation of wide spectrum of programmes which are aimed at poverty alleviation, employment generation, infrastructure development and social security. Over the years, with the experience gained, in the implementation of the programme and in response to the felt needs of the poor, several programmes have been modified and new programme have been introduced. This Ministry's main objective is to alleviate rural poverty and ensure improved quality of life for the rural population especially those below the poverty line. These objectives are achieved through formulation, development and implementation of programme relating to various spheres of rural life and activities, from income generation to environmental replenishment.



**4.3** The Department of Rural Development implements schemes for generation of self-employment and wage employment, provision of housing and minor irrigation assets to rural poor, social assistance to the destitute and Rural Roads. Apart from this, the Department provides the support services and other quality inputs such as assistance for strengthening of DRDA Administration, Panchayati Raj Institutions, Training & Research, Human Resource Development, Development of Voluntary Action etc. for the proper implementation of the programme. The major programme of the Department of Rural Development includes Pradhan Mantri Gram Sadak Yojana, (PMGSY).

## **5 National Highways Authority of India**

**5.1** The National Highways Authority of India (NHAI) was constituted by an Act of Parliament, the National Highways Authority of India Act, 1988. It is responsible for the development, maintenance and management of National Highways entrusted. The Authority started functioning in February, 1995 with the appointment of full time Chairman and other Members. NHAI is mandated to implement National Highways Development Project (NHDP) which is India's largest ever highway project with World class Roads for uninterrupted traffic flow and enhanced safety of road users.

**5.2** NHDP (Phase I & II) was launched in 1999 covering a length of nearly 14,000 km at an Estimated Cost of Rs. 54,000 crore (at 1999 prices) and NHDP (Phase III) was launched in 2005 for upgradation and 4 laning of 10,000 km of selected high-density corridors of National Highways at an Estimated Cost of Rs. 55,000 crore (at 2005 prices).

**5.3** As per the Government mandate NHAI is shifting its emphasis from hitherto followed 'Construction Contracts' to 'Build Operate Toll (BOT) Contracts' on toll basis to develop projects from NHDP-Phase III onwards. This programme is Estimated to cost about Rs. 2,36,000 crore, Under NHDP Phase-V and stretches of about 20,000 km of NHs are envisaged to be improved to 2-lane standards with paved shoulders. For the NHDP Phase-V, Government has approved the proposal for 6-laning of 6500 km of selected stretches of existing 4-lane roads on Design, Build, Finance and Operate (DBFO) basis. For NHDP Phase –VI, the Government has approved the proposal for the development of 1000 km of access controlled 4/6 lane divided carriageway expressways on BOT basis.

## **6 Border Roads Organization**

**6.1** The Border Roads Organization (BRO) is a road construction execution force, integral to and with support of the Army. It started operations in May 1960 with just



two projects; Project Tusker (renamed Project Vartak) in the East at Tejpur and project Beacon in the west. It has grown into a 13-project force, supported by a well-organized recruiting/training centre and two well-equipped base workshops for overhaul of plant/equipment and two Engineer Store Depots for inventory management.

**6.2** The BRO has not only linked the border areas of the North and North-East with the rest of the country, but also contributed to the execution of road works in Bihar, Maharashtra, Karnataka, Rajasthan, Andhra Pradesh, Andaman and Nicobar Islands, Uttarakhand and Chhattisgarh.

**6.3** The BRO constructs and maintains roads in the border areas, classified as General Staff (GS) roads, in keeping with Defence requirements. Besides GS roads, BRO also executes Agency Works, which are entrusted to it by other Central Government Ministries and Departments. Works entrusted by Public Sector Undertakings, State Governments and other Semi-Government Organizations are executed as Deposit Works. Over the years, the BRO has diversified into the construction of airfields, permanent steel and pre-stressed concrete bridges and housing projects.

**6.4** The BRO has been playing a vital role in construction and maintenance of roads under their charge. They have acquired special expertise and field experience of working in difficult areas and rugged terrain, particularly in the NE Region. BRO need support of the State Governments for availability of land as also environment and forest clearances.

## **7 National Rural Roads Development Agency**

**7.1** The National Rural Roads Development Agency (NRRDA) was established in January, 2002 to extend support to the programme of Rural Roads by way of advice on technical specifications, project appraisal, quality monitoring and management of monitoring systems. The agency has been conceived as a compact, professional and multi-disciplinary body to provide requisite technical and management support to the Ministry of Rural Development and to the State Governments for effective implementation of the Pradhan Mantri Gram Sadak Yojana (PMGSY) programme.

**7.2** The National Rural Roads Development Agency has been set up primarily with the following objectives:

- i) To discuss with different Technical Agencies and arrive at appropriate Designs and Specifications of Rural Roads and, thereafter, to assist the Ministry of Rural Development in prescribing the Designs and Specifications of Rural Roads, including Bridges and Culverts.

- ii) To render assistance to States or Union Territories in preparing District Rural Roads Plans.
- iii) To scrutinize or arrange to scrutinize the proposals received from States and Union Territories for consideration by the Ministry of Rural Development.
- iv) To set up an "On-line Management and Monitoring System", incorporating both intranet and internet-based system, for obtaining updated information to facilitate a ready viewing and screening of data.
- v) To monitor the expenditure incurred by the States or Union Territories in implementation of the Pradhan Mantri Gram Sadak Yojana, with reference to the funds released by Ministry of Rural Development through expenditure reports obtained from the States or Union Territories and through 'On-line Management and Monitoring System.
- vi) To take up Research activities relating to Rural Roads, including execution of Pilot Projects.
- vii) To study and Evaluate different Technologies in respect of Rural Roads and to take up pilot projects involving different technologies.

## **8 The State Rural Road Development Agency (SRRDA)**

**8.1** The State Rural Road Development Agency (SRRDA) is responsible for rural roads. They have a distinct legal status under Registration of Societies Act. This agency has a nodal or coordinating role for entire rural sector in State, which receive fund from MORTH for PMGSY programme. The functions of agency in relation to PMGSY include: (i) Rural road planning and sectoral coordination; (ii) Management of funds; (iii) Preparation and submission of annual proposals; (iv) Work management; (v) Contract management; (vi) Financial management; (vii) Quality management; and (viii) Maintenance management.

**8.2** The SRRDA has to appoint a Financial Controller, to oversee operational-ization of rural road accounting system. Agency shall maintain centralized accounts, which will be accessed by Programme Implementing Units (PIU). Financial Controller's primary responsibility would be enforcement of accounting standards and arranging auditing thereof.

## **9 Central Public Works Department**

**9.1** The Central Public Works Department (CPWD), is the principal agency responsible for creating assets for various Ministries and Departments of the Government of India (except Railways, Defence, Communication, Atomic Energy, Airports Authority of India and All India Radio). About 150 years back in July 1854, CPWD came into existence as a central agency meant for carrying out all public works. However, it was in 1930, that the CPWD got organized into its existing structure. Over the years, the CPWD has executed wide variety of civil works ranging from building residential accommodation and office complexes to roads, bridges, airports and border fencing, not only in the country but also in neighboring countries of South Asia.

**9.2** CPWD has well documented Manuals, Specifications and Standards, Schedule of Rates, Accounts codes etc. which are updated from time to time, and are used extensively by various construction agencies in the country, be it in the public or private sector. CPWD is under the administrative control of the Ministry of Urban Development (MOUD) and acts the chief professional advisor to Ministry of Urban Development in all matters concerned with public works. It is also the principal adviser to the Government of India on all technical matters related to civil, electrical and mechanical engineering as also horticulture and architecture works. CPWD is also associated with implementation of some of the projects under PMGSY in the State of Bihar and for construction of roads in border areas in eastern and western sectors.

## **10 Central Road Research Institute, New Delhi**

**10.1** The planners of the country had recognized the need for national research and development in all branches of science and technology. The establishment of the chain of National Laboratories under the Council of Scientific and Industrial Research (CSIR) was a major step in this direction. The Central Road Research Institute was one such Laboratory set up for the road sector in the early 1950's in New Delhi. The major activities of CRRI cover basic research, applied research and dissemination of research findings related to highway engineering. The beneficiaries of research work includes road organization of Government, Contractors, Consultants, Oil companies, Cement manufacturers and other road and traffic management agencies.

**10.2** The important research areas of the CRRI are: (i) Road Development Planning and Management; (ii) Traffic Engineering Safety and Environment; (iii) Engineering Safety and Environment' (iv) Pavement Engineering and Materials; (v) Geotechnical and Natural Hazards; (vi) Bridge Engineering and Management and (vii) Instrumentation



**10.3** The major achievements of the CRRI includes: (i) Road user cost study (input to World Bank HDM-III, HDM-4); (ii) Land slide mitigation strategies (hill regions); (iii) Consolidation of marine clay (coastal belts); (iv) Soil stabilization techniques; (v) Pavement deterioration prediction models; (vi) Use of flyash and other industrial waste in roads; (vii) Road Safety Audits, Traffic Management Measures; (viii) Non destructive testing of bridges; (ix) Road Condition Evaluation Devices, Bump Integrator and (x) CC block pavement in deserts and mountains

**10.4** Following are some of the activities of CRRI, currently involved for studies in: (i) Road Information System; (ii) Slope protection strategies in hills; (iii) Maximizing use of marginal/waste material; (iv) Engineering safety measures; (iv) Refining pavement condition prediction models; (v) Diagnostics of distressed bridges; and (vii) Pilot testing of innovative materials

**10.5** The CRRI has networking arrangements with several international organizations to enhance their quality of output. The major ones with whom the CRRI has such arrangements are: (i) Transportation Research Board, USA; (ii) Transport Research Laboratory, UK; (iii) Australian Road Research Board, Australia; (iv) LCPC, France; (v) PIARC (World Roads Congress), Paris; (vi) International Road Federation (IRF), Geneva and (vii) CSIR, South Africa

## **11 National Institute for Training of Highway Engineers, NOIDA**

**11.1** National Institute for Training of Highway Engineers (NITHE) is a registered Society under the administrative control of the Ministry of Road Transport and Highway. It is a collaborative body of both Central and State Governments and was set up in the year 1983 with the objective of fulfilling the long felt need for training of Highway Engineers in the country, both at the entry level and during the service period. The broad activities of National Institute for Training of Highway Engineers (NITHE) consist of: (i) Training of freshly recruited Highway Engineers; (ii) Short duration technical and management development courses for Middle and Senior Level Engineers; (iii) Training in specialized areas and new trends in highway sector and (iv) Development of training materials, training modules for domestic and foreign participants.

**11.2** Since its inception, the NITHE has trained 12,000 Highway Engineers and Administrators involved in road development from India and abroad through more than 500 training programmes (upto December 2006). Participants are drawn from Ministry of Shipping, Road Transport and Highways, various State PWDs, Rural Engineering Organizations, Public Sector, Private Sector and NGOs involved in the field of Highway Engineering. Engineers from foreign Government Departments have



participated in NITHE's International, SAARC and Technical Co-operation Scheme of Colombo Plan. It has also compiled a number of Manuals useful for engineers and their organizations.

## **12 State Public Works Departments**

**12.1** The critical role in execution of road projects rests with the Public Works Departments (PWDs) in the States. They also implement Works on National Highways on ground except the segments of National Highways entrusted to Border Roads Organization and NHAI. The State PWDs are responsible for policy, planning, construction and maintenance of State Roads. The State PWDs are performing extremely vital role in provision of road infrastructure on the ground. However, they need to be reoriented to the needs of current emphasis on private sector participation and implementation of large scale projects with available assistances from the multilateral funding agencies like the World Bank, the Asian Development Bank and the Japanese Bank for International Cooperation.

**12.2** Several States have already taken the initiative of reviewing their current procedures, strengths and weaknesses in the existing system. States like Andhra Pradesh, Gujarat, Karnataka, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, etc. have completed institutional development strategy studies. Many other States have also initiated the process. The Account Codes and Works Manuals of the State PWDs need review in the light of procedural changes made at the Central level to keep pace with the latest emerging technologies. There should be proper synchronization of the procedures and systems at the Central and State levels.

## **13 Rural Engineering Organizations in the States**

**13.1** For executing Rural Roads Projects each State Government has to identify a suitable agency having its presence in all districts and having established competence in executing road construction work. These are designated as Executing Agencies and could be PWD/Rural Engineering Services/Rural Engineering Organizations/Rural Works Departments/Zila Parishads/Panchayati Raj Institutions. Each State Government has also to nominate Nodal Department which shall have overall responsibility for implementation of PMGSY in the State.

**13.2** In actual practice there is no uniformity of organizations handling the programme of Rural Roads and different practices are being adopted in different States. In some States, the entire responsibility of construction, maintenance as well as planning lies with the district level bodies like Zilla Parishads and Block

Level Panchayat Samities under the administrative control of Rural Development Departments, while in some States such functions are carried out by local bodies only in respect of Village Roads and Community Development Roads (Non-Plan Roads, etc.). In some States, the entire subject of District Roads is left to District Administration like Zilla Parishads including their planning through District Planning and Development Councils (DPDCs). In some States, not having established Zilla Parishads, all aspects of roads are dealt with by the PWDs or Rural Engineering Organizations (REOs). In many States, planning functions are carried out by the PWD even though survey, design, construction and maintenance of Rural Roads are under the control of Zilla Parishads.

**13.3** There is need for uniformity of approach in planning, construction and maintenance of rural road programme having regard to different terrain, climate and socio-economic environment. Where necessary, Zilla Parishads should be supported with technical assistance by PWDs. While construction may be done by the PWDs/REOs, maintenance functions may be entrusted to local bodies, which should be provided with adequate funds and supported with technical trained manpower. This would require upgrading the quality of technical inputs in the organizations handling the work of rural roads.

## **14 Contractors**

**14.1** For number of years the Contracting industry in the highway sector remained in a nascent state. As recently as in the eighties of the last Century Employees were taking all decisions for implementing Highway Projects. Contractors were individuals of meager resources and almost ignorant of the technology and know-how but for a few exceptions in construction of bridge structures, most members of the industry were having annual turnover was in terms of a few crore rupees. They were unorganized, had little resources and infrastructure and were operating mostly at Taluka levels. Their interaction was confined to lower level functionaries like Sub Divisional Officers and Executive Engineers and in some cases upto the level of Superintendent Engineers. Chief Engineers used to be beyond reach for most members of the industry. The size of the projects were limited to a few crore rupees and involved only components of the road structures, viz. earthwork, collection/transportation of road materials and labour charges for doing individual items of work. The work given to individual contractor never involved construction of the road in its entirety. Most members of the Industry Road had a few units of equipments like Graders, Excavators, Road Rollers and the like. Hardly any qualified technical personnel used to be on the rolls of the Industry members.

**14.2** Gradually, with the liberalization of the Indian economy towards the end of the last century, medium to large size projects came into vogue. Employers started inviting bids for bigger projects, of say up to Rs.100 crore, on similar lines as that of developed countries. Keeping pace with the development and to utilize the growing opportunities, the Indian Construction industry also transformed itself both in size and capacity; but it was still not large enough to cope up with the demand and requirements of such bigger projects. To begin with, the pre-qualification (PQ) criteria were beyond most of the members of the industry. Very survival necessitated innovative measures. This forced most members of the industry to have joint ventures between themselves and with the foreign companies. Cost of constructions of road work in the developed countries being many fold as compared to that of India, foreign companies could fulfill the PQ criteria quite easily although their overall size and work experiences in many cases was only marginally higher than their Indian counterparts. Foreign companies exploited the situation to their advantage and more often than not just lent their names as Joint Venture partners. They seldom involved themselves with actual construction activities and their presence in the country was confined to a few functionaries. The passive presence of the foreign partners forced the Indian counterparts to man and manage the bigger size projects by themselves albeit under the overall umbrella of the foreign partners. This gave opportunity to the Indian contracting industry to grow by leaps and bounds as also muster enough resources and upgrade themselves technologically for handling bigger size projects. This also necessitated inculcation of corporate culture, for management of projects professionally and delivery of quality products. Opening up of the Indian economy also enabled the Industry to acquire / import modern construction equipments at competitive cost, gain know-how more easily and above all transform themselves from family owned and oriented business to private limited companies employing thousands of work force and Engineers. Many members of the industry are now owners of key construction equipments like graders, excavators, rollers, concrete batching plants, hot mix plants etc. Their yearly turnovers in most cases have leap frogged 10 times in the last decade. They are in a position to undertake projects of any size and are also spreading their wing overseas. Such phenomenal rise of the Indian construction industry in such a short time is unparalleled. The National Highways Builders Federation (NHBF) is the single largest body of highway builders in the country representing 52 companies.

## **15 Developers and Concessionaires**

**15.1** With the highway sector thrown open to private sector for financing on BOT basis, several entrepreneurs and contractors are coming forth as developers and concessionaries in the sector. The Government has developed Model Concession



Agreement which provides for rights and responsibilities of the concessionaire and the Government as also a fair allocation of risks between them. The Concessionaire develop the project, undertakes detailed design and arranges the necessary funds including the grant from the Government. He, then arranges construction of the project either through his own resource or through hiring outside contractors. On completion of the works, he gets entitlement of collecting tolls from the road users at designated toll plazas and undertakes operation and maintenance as also management of the highway project duly meeting the performance requirements laid down in the agreement during the concession period, which may be in the range of 20 to 25 years. The Concessionaire also undertakes to provide several project facilities for road users – such as rest areas, busbays, truck lay byes, highway traffic management system, incidence management, ambulance, towaway crane etc. Quality of service to road users and traffic management measures are generally arranged by the Concessionaires through dedicated O&M operators and Highway Patrol units. The NHAI and several State Governments have succeeded in undertaking road projects through private financing on BOT(Toll) and BOT(Annuity) Models.

**15.2** Financial Institutions are involved in providing funds to the Concessionaire. Some of the financial institutions which are actively involved in highway development are World Bank, Asian Development Bank, Indian Development Finance Corporation, Infrastructure Leasing and Financial Services, Indian Infrastructure Finance Co. Ltd. NABARD, JBIC, SBI Caps and ICICI Infrastructure Division.

## **16 Consultants**

**16.1** The consultancy profession in the field of roads and bridges has grown and a number of domestic firms have graduated to international stature. Besides, a number of international firms from abroad are forming joint ventures with domestic firms or have established their own subsidiary units in India with majority of domestic professionals. Not only large firms, but even medium size firms are now equipped with latest state-of-art survey instruments and laboratory testing equipment and many of them have on their roster experienced surveyors, material engineers and laboratory technicians.

**16.2** Consultancy has different dimensions and scope of work including planning, design, traffic and transport studies, Quality Control and supervision etc. For promotion of consultancy; the Consultancy Development Centre (CDC), an autonomous body was set up by the Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology, Government of India. CDC provides skill up-gradation to consultants, including running a post graduate programme leading to Masters in



Consultancy Management in collaboration with BITS-Pilani, a deemed university. Another organization set up by the professional consultants, both individual and Institutional is CEAI. CEAI is the member association of FIDIC in India. They conduct Training and Seminars for promotion of consultants.

## **17 Tools, Plants and Equipment Manufacturer/Supplier**

During last decade, the role of tools, plants, and equipment manufacturers as also suppliers have increased many fold. The policy of the Government is for facilitating use of sophisticated machinery in the highway sector in the wake of intensive mechanization in development and maintenance activities through measures such as exemption of import custom duty etc. and also exemptions from custom and excise duties being granted in case of the projects funded by the World Bank and Asian Development Bank. There have given a boost to the domestic equipment manufacturing industry.

## **18 Material and Product Manufacturer/Supplier**

The cement and steel manufacturing companies, refineries producing bitumen/modified bitumen and bituminous products etc., suppliers/manufacturers of various patented products such as bridge expansion joints, bridge bearings etc., companies supplying/manufacturing various equipments/devices pertaining to Traffic and Transportation Systems such as Weigh-in-Motion systems, Automatic Traffic Counters –cum–Classifiers, Crash Barriers, Delineators, Impact Attenuating Devices, Signs and Markings etc., also play a prominent and important role in the development of highway network.

## **19 Indian Roads Congress**

**19.1** The Indian Roads Congress (IRC) is the premier technical body of Highway Engineers in the country. The IRC was formed in December, 1934 on the recommendations of the Indian Road Development Committee known as Jayakar Committee set up by the Govt. of India with the objective of Road Development in India. As the activities of the IRC expanded, it was formally registered as a Society in 1937 under the Societies Registration Act of 1860. Over the years, the IRC has burgeoned and grown into a multi-dimensional multifaceted organization, devoted to the cause of better roads in the country.

**19.2** The Congress provides a national forum for sharing of knowledge and pooling of experience on the entire range of subjects dealing with the construction and maintenance of roads and bridges, including technology, equipment, research,

planning, finance, taxation, organization and all connected policy issues. In more specific terms, the objectives of the Congress are:

- i) To promote and encourage the science and practice of building and maintenance of roads;
- ii) To provide a channel for the expression of collective opinion of its members regarding roads;
- iii) To promote the use of standard specifications and to propose specifications;
- iv) To advise regarding education, experiment and research connected with roads;
- v) To hold periodical meetings, to discuss technical questions regarding roads;
- vi) To suggest legislation for the development, improvement and protection of roads;
- vii) To suggest improved methods of administration, planning, design, construction, operation, use and maintenance of roads;
- viii) To establish, furnish and maintain libraries and museums for furthering the science of road making;
- ix) To publish, or arrange for the publication of proceedings, journals, periodicals and other literature connected with the road sector.

**19.3** In order to fulfill its objective to advise regarding education, knowledge and research connected with roads, the IRC has to fulfill its objective in broader terms by showing a way forward to highway sector for education and research needed for proper development of roads. The Human Resource Committee of the IRC has been given responsibility to develop such documents which will be helpful in capacity building of organizations and enhancing capacity and capability of individuals; from high level professionals to workers. The documents are also required to be developed to make available the information about everything connected with highway sector.

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## CHAPTER 5

### OTHER RELATED ORGANIZATIONS

#### 1 Multifaceted Concern

After introduction of economic reforms and accepting the need for developing highway sector in a big way there has been shared perception that emphasis need be given for a paradigm shift from the linear approach to a more coordinated approach within overall ambit of integrated transport policy with optimal inter-modal mix and emphasis on safety, energy efficiency and conservation, environment protection, self sustaining and viable transport units. Fourth Road Development Plan in its formulations addressed to multifaceted concern of highway sector covering diverse areas like capacity building in highway departments, consultancy sector and construction industry, incidence management, improving energy efficiency, private sector financing of projects with equity based profit and risk sharing. This has led to creation and participation of numbers of complimentary organizations and agencies who are engaged in supplying the needed competency based inputs to enable the principal highway agencies to take decisions more objectively and implement projects on a more scientific basis with strengthened knowledge and skill capabilities. This chapter, accordingly, covers such organizations/agencies which are supporting and contributing to the core organizations and are drawn from the field as diverse as policy planning and funding organizations to organizations engaged in research and development, regulatory, environmental, training, testing and other support functions.

#### 2 State Planning Departments

**2.1** Except for the National Highways and Central Government funded schemes, all roads and highways are in the purview of State Governments. The proposals are framed by the State Public Works Departments and other Departments dealing with highways and comprehensive scheme for Highways Sector is framed by the State Planning Departments under the control of Secretary (Planning). These proposals are part of State Plan. The annual physical and financial targets are prepared on the basis of already approved Five Year Plans, depending upon the status of roads and nature of requirements. The funding of such proposal is done through Planning Commission, Government of India and revenue generated by the State Governments.

**2.2** The State Planning Departments have vital role to play as they decides about priorities and allocation of funds. Thus, State Highways, MDR, ODRs and Village



Roads are controlled by the State Governments. The exception to this is Rural Roads which are dealt under Central Government funded schemes.

### **3 Council of Scientific & Industrial Research (CSIR)**

**3.1** The Council of Scientific & Industrial Research (CSIR), the premier industrial R&D organization in India, was constituted in 1942 by a resolution of the then Central Legislative Assembly. It is an autonomous body registered under the Registration of Societies Act of 1860. CSIR aims to provide industrial competitiveness, social welfare, strong S&T base for strategic sectors and advancement of fundamental knowledge. The Strategic Road Map designed for CSIR as it stepped into the new Millennium envisaged: (i) Re-engineering the organizational structure; (ii) Linking research to market space; (iii) Mobilizing and optimizing the resource base; (iv) Creating an enabling infrastructure; and (v) Investing in high quality science that will be the harbinger of future technologies.

**3.2** The Government of India in its "Science and Technology Policy 2003" presents Science and Technology with a human face and emphasizes realities such as facing open, global competition; need for examining social, economic and environmental consequences of S&T; and, aggressive international benchmarking and innovation. It advocates strong support for basic research, emphasizes manpower build-up and retention as important challenges. It further advocates dynamism in S&T governance, through the participation of scientists and technologists.

**3.3** Today, CSIR is recognized as one of the world's largest public funded R&D organization having linkages to academia, R&D organizations and industry. CSIR's network of 38 laboratories not only knits India into a giant network that impacts and adds quality to the life of each and every Indian, but CSIR is also party to the prestigious Global Research Alliance with objective of applying knowledge pool for global good. CSIR's R&D portfolio embraces areas as diverse as Highways, Structural Engineering, Aerospace, Biotechnology, Chemicals, etc. The R&D organizations under the aegis of CSIR involved primarily in R&D related to Highway sector are Central Road Research Institute (CRRI), New Delhi, Central Electrochemical Research Institute (CECRI), Karaikudi and Structural Engineering Research Centre (SERC), Chennai.

### **4 The Structural Engineering Research Centre (SERC), Chennai**

**4.1** The Structural Engineering Research Centre (SERC), Chennai has facilities and expertise for the analysis, design and testing of structures and structural components. Services of SERC are being extensively taken by the Central and State



Governments and Public and Private Sector Undertakings. Scientists of SERC serve on many National and International Committees and the Centre is recognized as a leading research institution in the field of structural engineering. SERC has recently been certified as ISO:9001 quality institution.

**4.2** SERC acts as a clearing house for the latest available knowledge and develops know-how on design and construction of all types of structures. It undertakes application-oriented research in all aspects of structural engineering – both design and construction, including rehabilitation of structures. It also provides design consultancy services, including proof checking to organizations in the Public and Private Sectors for developing a variety of structural designs. SERC also organizes specialized courses on structural engineering for the benefit of practicing engineers to familiarize them with the latest developments in analysis, design and construction. Major Testing Facilities are also available at SERC. Besides, the Centre has also been publishing the Journal of Structural Engineering.

## **5 Central Electrochemical Research Institute, Karaikudi**

**5.1** The Central Electrochemical Research Institute (CECRI) is the largest research establishment for electrochemistry in South Asia, headquartered at Karaikudi. It has extension centers in Chennai, Mandapam and Tuticorin. The institute works on all facets of electrochemical science and technology: Corrosion Science and Engineering, Electrochemical Materials Science, Functional Materials and Nanoscale Electrochemistry, Electrochemical Power Sources, Electrochemical Pollution Control, Electrochemical, Electrodeics and Electrocatalysis, Electrometallurgy, Industrial Metal Finishing, as also Computer Net-working and Instrumentation. CECRI runs several projects in collaboration with laboratories from within and outside India.

**5.2** The area of expertise of CECRI relevant to the highway sector/structures such as bridges are corrosion control in concrete structures including their monitoring, condition survey of existing structures including assessment of their residual life based on corrosion, cathodic protection of foundations and sub-structures, repair and rehabilitation of corrosion, cold applied reflective road marking paints, etc.

## **6 The Gujarat Engineering Research Institute (GERI), Vadodara**

**6.1** The Gujarat Engineering Research Institute (GERI), established in 1950, was developed into a research division by 1957. It attained a status of a State Research Institute in 1960. GERI had the distinction of being adjudged as one of the best research stations in the country. The institute aims at providing research and development inputs

to the activities of Gujarat State in the fields of Water Resources, Roads and Buildings. The activities of the institute are centered around investigation and testing, research and development, constancy and training in various areas listed earlier. The institute extends its activities to both Government and Public/Private Sector bodies

**6.2** The R&D activities related to the highway sector undertaken in the institute are related to soil mechanics, foundation engineering, geo-textile, reinforced soil, non-destructive testing of concrete, fibre reinforced concrete, geo-physical and seismological investigations, flexible pavement, traffic and transportation, etc.

## **7 The Highway Research Station, Chennai**

The Highway Research Station (HRS), Chennai is engaged in the applied research, in construction and maintenance of roads and bridges and traffic pattern. It has well-equipped laboratories for Soil and Foundation Engineering, Concrete and Structures, Bitumen and Aggregate and Traffic and Transportation.

## **8 The Maharashtra Engineering Research Institute (MERI), Nashik**

MERI comprises of ten research divisions involved in various research and testing activities, including Highway Research Division. The institute caters to the needs of projects under Irrigation and Public Works Departments, Maharashtra Jeevan Pradhikaran (MJP) and ports authorities in Maharashtra. More than 250 technical and scientific staff is involved in the research and testing activities of the institute. Besides doing basic research in Civil Engineering, the institute mainly deals with the field problems or applied research work.

## **9 Other Organizations involved in R&D related to Highway Sector**

Apart from the above mentioned premier organizations, Research Laboratories set up by several State Governments, the R&D centres in the Public/Private Sector notably IOC, Bharat Petroleum, Hindustan Petroleum, ACC, etc. are also contributing significantly in their niche areas. IITs, NITs, Engineering Colleges, School of Planning and Architecture, Delhi (Department of Transport Planning) are also undertaking R&D work in several areas of the highway sector.

## **10 Other Organizations and Educational Institutes providing Training Programmes**

Various organizations involved with R&D activities in the Highway Sector also offer short term training courses, e.g. CRRI, New Delhi, SERC, Chennai, etc. Besides,

specialized training programmes are also organized by the eminent Academic Institutes offering Civil Engineering courses, such as the IITs, IISc Bangalore etc.

## **11 Training Institutes Attached with the Government Organizations**

Major Government organizations are either having their own training institutes or training of professionals in highway sector is imparted by the training institutes run by the State Government. Central PWD is having its training institute situated at Ghaziabad and offers training courses to engineering professionals. For training of junior level and middle level professionals Regional Training Institutes are run by Central PWD at Delhi, Kolkata, Mumbai and Chennai. The Workmen Training Centres are also run at these places for the Workmen directly employed by Central PWD for maintenance. Uttar Pradesh PWD, have developed detailed curriculum on road construction technology and laboratory training, covering class room and on-site training to its junior and senior engineers. Other States like Rajasthan are also imparting training through State-run training institutes.

## **12 Construction Industry Development Council (CIDC)**

For training of workmen and supervisors, CIDC has developed several training institutes in the country. They have also initiated training programmes directly at project sites. Besides, CIDC is coordinating with equipment manufacturers for training of equipment operators.

## **13 National Academy of Construction, Hyderabad**

The National Academy of Construction (NAC), the only institute of its kind, is controlled by Government of Andhra Pradesh. It is doing yeomen's service both for training of workmen and professionals. It is funded through cess levied by State Government on construction contracts.

## **14 Training by Contracting Organizations**

Contracting Organizations and their Associations are also conducting training Programmes at different places all over the country. Firms like L&T have their training institutes for workmen.

## **15 National Accreditation Board for Testing and Calibration Laboratories (NABL)**

**15.1** National Accreditation Board for Testing and Calibration Laboratories (NABL) is an autonomous body under the aegis of Department of Science & Technology,



Government of India, and is registered under the Societies Act. NABL was established with the objective to provide Government, Industry Associations and Industry in general with a scheme for third-party assessment of the quality and technical competence of testing and calibration laboratories. Government of India has authorized NABL as the sole accreditation body for Testing and Calibration laboratories. NABL provides laboratory accreditation services to laboratories that are performing tests/calibrations in accordance with ISO and ISO 15189:2003 for medical laboratories. These services are offered in a non-discriminatory manner and are accessible to all testing and calibration laboratories in India and abroad, regardless of their ownership, legal status, size and degree of independence.

**15.2** NABL has established its Accreditation System in accordance with ISO/IEC 17011:2004, which is followed internationally. In addition, NABL has to comply with the requirements of APLAC MR001, which requires the applicant and the accredited laboratories to take part in recognized Proficiency Testing Programmes in accordance with ISO/IEC Guide 43. An applicant laboratory has to satisfactorily participate in at least one Proficiency Testing programme, while the accredited laboratories are expected to cover the major scopes of accreditation in a cycle of four years. Annual Surveillance is carried out to ensure that the accredited laboratories are continuing to comply the accreditation criteria. NABL and its accredited laboratories are also required to meet the new challenges arising out of requirements such as satisfactory participation in a recognized Proficiency Testing Programme and the requirement of estimating the uncertainty in measurements even by the testing laboratories.

## **16 BIS Laboratories**

The network of eight BIS laboratories, spread throughout the country provide conformity testing of BIS certified products against relevant Indian Standards. Central Laboratory at Sahibabad (near Delhi) and the laboratories at Regional and some Branch Offices are engaged in testing primarily for operation of the BIS Certification Mark Scheme. The major areas covered under testing at the Central Laboratory are electrical, mechanical and chemical and calibration. Apart from Central Laboratory at Sahibabad, BIS has four regional laboratories at Mumbai, Kolkata, Chennai and Mohali as also branch laboratories at Patna and Guwahati. BIS also develops specifications for test equipment and offer calibration services, as also trained testing personnel.

## **17 Independent Testing Laboratories**

In the field of conducting, test of materials, independent Laboratories established in the Private Sector are also playing a prominent role. Such Laboratories need accreditation



by NABL and proper calibration of each and every equipment according to specific requirements. The Laboratory Assistants who conduct tests must have required training. For any Laboratory, the track record of the past performance decides about its credibility.

## **18 Laboratories with Engineering Institutes and Research Organizations**

Engineering Institutes and Research Organizations have their in-house laboratories which not only serve for students & research scholars of the institutes but also conducts tests on the material as received from the project sites. These organizations also help in developing Job Mix formulae, Design Mix for Concrete etc. as per the requirement of projects.

## **19 Development Bodies and Participatory Agencies**

**19.1 Urban Development Bodies:** In urban areas, roads are part of urban infrastructure and accordingly, roads schemes are prepared and implemented within the overall plan of city development. Sometimes, the city area is divided between municipal Council and Improvement trust, which are statutory bodies constituted with the specific purpose of promoting the development of cities. Road schemes in city areas need approval from such urban Improvement Trust or Development Authority. An expanded version of an urban Improvement Trust is Delhi Development Authority (DDA), which was set up with a view to promote and develop Delhi according to Master Plan as approved for twenty years period. Road construction schemes including bridges and flyovers in Delhi are required to be approved by DDA. Besides, the approval of Delhi Urban Arts Commission is also necessary.

**19.2 Panchyat Raj Agencies:** The 73<sup>rd</sup> Constitutional Amendment Act of 1993 envisioned a vibrant Panchayati Raj system, responsive to the needs and aspirations of the local community, where informed and inclusive participation of all citizens, cutting across caste, class and gender, in the planning and administration ensures accountability of the system to the local community. The Act provides for creation of three tier system- Gram Panchayat at the village level, Janpad-Panchayat at the Block level and Zila-Panchayat at district level, with sufficient power and functions contained in the Schedule appended to the Act like creation of Financial Commission for strengthening their financial position. These agencies though are not planning & development bodies, but different State Governments can enact their own legislations to assign them functions relating to implementation of schemes of economic development and social justice like PMGSY and development of other rural connectivity schemes.

**19.3** Electrical Transmission Lines: Electric generation, supply and distribution in different States are largely in Public Sector, with respective Electricity Boards controlling generation and transmission of electricity. In metropolitan areas, distribution system gradually is being transferred to private distribution agencies as a part of reforms brought about in electricity sector consequent to enactment of Electricity Act 2003. Accordingly, as per the directives issued by the State Governments or Electricity Regulatory Commissions of the States, different agencies operating in States are to be coordinated for shifting of electricity transmission lines interfering with ROW or laying of electrical transmission lines for lighting of highways especially in urban areas or along designated stretches of highway projects.

**19.4** Municipal & other agencies: Municipal bodies and Jal Boards and controlling water supply, sewerage, drainage especially in cities and metropolitan areas are to be interacted and permission obtained for shifting of utilities and for connecting road side drainage with the city drainage system. Telephone, internet, gas supply are other utilities which are found criss-crossing city-scape and are needed to be properly dovetailed into the road projects to avoid any disruption by way of un-intended cutting of cables, ducts or supply pipes.

## **20 Environmental Protection Agencies**

**20.1** With increasing need and urgency for preserving and enhancing natural environment for the subsistence of human life, Governments, world over, are examining all development projects from environmental point of view, before allowing their execution. Principal environment regulatory agency in India is Ministry of Environment & Forest. This Ministry formulates policies and decides whether to allow the project to proceed or whether to alter or abandon it.

**20.2** The key environmental legislations regulating the environmental aspects of a project are (a) The Water (Prevention and Control of Pollution) Act, 1974, (b) The Air (Prevention and Control of Pollution) Act, 1974 (c) The Forest Act, 1927 (d) The Forest (Conservation) Act 1980, (e) The Wild Life (Protection) Act, 1972 and (f) The Environment (Protection) Act, 1986. Ministry of Environment and Forest, from time to time, issues notification under the provisions in the Environment (Protection) Act, 1986 specifying requirements in respect of Highway Projects like all Highway Projects costing Rs. 50 crore or more shall not be undertaken unless they have been accorded Environmental Clearance and others concerning requirement of public hearing for projects seeking environmental clearance, Coastal Regulation Zones etc. For any ecological sensitive area, if Ministry of Environment and Forest has appointed any statutory authority for clearing the projects, such authority's clearance is also necessary, for the project in that area.

**20.3** Highway Projects require approval from the Ministry of Environment and Forest. Detailed proposals are required to be prepared based on ground studies done by the experts for such approval. Under the Environment (Protection) Act 1986 and the Forest (Conservation) Act 1980, the steps required to be taken for obtaining Environmental clearance from Government of India involves steps like (a) Preliminary study of different alternative alignments from technical and environmental point of view (b) Preparing feasibility report and detailed EIA in respect of chosen alignment (c) Obtaining clearances from the concerned State Pollution Control Board (d) Submission of proposal to Ministry of Environment and Forest in required proforma alongwith documents like project report, EIA report as per IRC: 104-1988, report of public hearing, clearance from State Pollution Control Board and recommendations from State Environment Department and (e) Proposal for diversion of forest land. If required presentation of Project is to be done to the Experts Committee.

## **21 Human Resource in Highway Sector**

**21.1** Organizations directly working for highways sector and manned with professionals and workmen belonging to this sector are dealt in Chapter-4. Whereas this Chapter has covered other related organizations manned by professionals who, though are also engaged in the highway sector development, but not exclusive, rather part of their overall responsibility extends to areas of other sectors as well. Each of these core as well as other related organizations/agencies/bodies call for different competencies to enable them to contribute effectively in highway sector development. Understanding their HR requirement is, therefore, necessary before one can conceptualize and plan HR requirement for the overall highway sector as such. In order to study requirement of human resource for highways sector, it is necessary to understand HR requirements both for core organizational and other related organizations.

**21.2** Various organizations, bodies, institutions and agencies whether engaged directly or and in supporting capacity for the development of Highways sector, are manned professionals and workmen who work in various capacities i.e. as individual for as a part of unit/group for fulfilling objectives of organizations. The efficacy of such outcome is contingent to congruity between organization's structure and process with those who man the organization. For devising ways and means for human resources development in highways sector, it is therefore necessary to understand organizational requirement.



## CHAPTER 6

### ORGANIZATIONAL REQUIREMENT

#### 1 Capacity Building

Dynamics of highway sector involving many direct, complementary, supporting and regulatory players for translating a development vision into reality, requires that all such organizations/agencies/bodies respond and work in synergistic manner at organization, process, group and individual level. This calls for capacity building-in the shape of continuous development, retention and harnessing the professional expertise, effective human resource management policies in recruitment, training, job assignment, transfer and postings, rewards and punishment, decision making, motivation, and cross function specialization to name a few. Harmonious blending of human resource development and human resource management with the organization development may be considered as one of the prime requirement for the development of highway sector. The organizational requirement of the client, consultant, contractor, research, training, quality assurance and other support organizations whether in government, autonomous or private sector are thus wide and varied, encompassing both the organization and those working in it.

#### 2 Government Organizations

**2.1** Without getting into the organization specific analysis, based upon the analysis of pitfalls in achieving the targets set in various Road Development Plans and the experiences gained from time to time, some of the key areas requiring focus of the various Government Organizations for improving and streamlining of the implementation of projects are summarized as under:

- i) Outsourcing of professional expert services for the design and construction supervision of complex multi-disciplinary large sized projects, large span/innovative bridges, environmental assessment studies, rehabilitation works, techno-economic analysis, etc. requiring special skills.
- ii) Peer review/proof consultancy for finalization of designs for complex mega projects.
- iii) Ensure that departmental officers do not become complacent and carry the feeling that they have very little role to play when professional

consultancy services are procured through outsourcing so as to obviate post construction stage problems, audit queries, legislative questions, complaints, arbitration and litigation, etc.

- iv) Faster decision making process in the organization, decentralization of power, greater autonomy at functional and execution levels.
- v) Promote conducive working atmosphere and professional pride amongst employees.
- vi) Right person for the assignment.
- vii) Continuation of the Officers assigned for the project without transferring them in between.
- viii) Depute officers for structured training courses periodically and specialized training courses for specific assignments.
- ix) Ensure long term commitment of consultants in the projects even beyond the project implementation period and defect liability period.
- x) Systematize project record keeping and archive for future guidance. Evolve mechanism to ensure availability of consultant's records/ documents even after the defects liability periods are over so that potential defects manifesting or disputes/claims arising for the project can be defended in various forums.
- xi) Encourage progressive use of information technology in all phases, i.e. project planning, designs, procurement of services, implementation and monitoring, operation and maintenance.
- xii) Inter-departmental co-ordination to resolve issues such as environmental clearance, land acquisition, utility shifting, encroachment removal, etc. during pre-construction phase.
- xiii) Ensure timely payments to the consultants and contractors.
- xiv) System of writing of Performance Appraisal Report (PAR) of the Consultant by the Employer's representative and submission at higher level upon project completion. Such reports to be attached to the dossier of the consultant in the organization for future reference.
- xv) Ensure that consultants indemnify the employer through professional performance guarantee against all claims, actions, damages, liability,

litigation, etc. in connection with negligent acts, errors, omissions of the consultants.

xvi) Evolve appropriate guidelines and procedures for administration and management of consultancy services.

xvii) Evolve effective Dispute Resolution/Arbitration Mechanisms.

### **3 Contracting Industry**

**3.1** Contractors are the major partners for both direct construction projects by the Government and BOT projects through private entrepreneurs. In the Nineties when the NHDP was launched by the Government, a need was felt for large size contracting firms/contractors to take up packages which involved modern mechanized construction system using plants, equipments and standards and specifications matching with the world standards. Now that many of indigenous contractors have come of age and have developed expertise to undertake medium to major value projects, there is need to evaluate their competence level to ensure that the firms are capable as regards their organizational and technical capabilities for undertaking the job and completing the same as per the required quality and speed delivery standards. For this purpose, Construction Industry Development Council (CIDC) set up by the Planning Commission, has instituted a system to grade the projects and contractors. This process, it is expected, will assist the consultants and clients in selecting proper contractors to execute the projects.

**3.2** With the increased emphasis on projects through the channel of Public Private Partnership (PPP) which has led over the years to the creation of many innovative instruments like BOT, BOOT, BOO projects, the private equity partners like developers and contractors would be required to undertake additional role in the risk sharing of concession agreement. They will also be required to be performed at global standard with due sensitization to the need for incorporation of Quality, Safety and Environment in their delivery standards. A close interaction between the Government, industry, Academia, R&D institutions and CIDC will help further the cause of Contractors and developers in highways sector. Skill up-gradation of different category of workers/ technicians/engineers to cover the gap between their available skill standards and standards as demanded from them has become absolute necessity and has to be undertaken by the Government and industry in the right earnest. Conditions have to be created for healthy growth of the domestic contractors with possible state of art technology transfer in the field of construction management, plants and equipment by seeking support from foreign contractors.



## **4 Consultancy Sector**

**4.1** The burgeoning growth and development of the road network after economic reforms in 1990s and further spurred by the ambitious targets set by the fourth road Development plan for the first quarter of 20<sup>th</sup> Century has created an enormous demand on the technical professionals. The limited availability of suitable technical professionals in the field has posed serious problems for effective and timely implementation of projects on a sustainable basis. This demand–supply gap of highway professionals is found to have a cascading effect as manifested in adversely affecting the pace of overall decision making and implementation process. Therefore, there has been need for the consultancy firms to join hands with the academic institutions and research institutions in the country to get their support in filling up the gap in provision of specialists.

**4.2** Notwithstanding the concomitant professional growth with pace of development in the highway sector, weaknesses have also been experienced particularly in preparation of Detailed Project Reports. Not many firms have any system of internal audit by independent persons before the outputs are delivered to the clients.

**4.3** The Consultants should ensure regular participation of the professionals employed with them, in the skill up-gradation programme organized by Consultancy Development Centre (CDC). CDC is putting in place an accreditation and grading system for Consultants. This will assist the clients to make a considered decision in selection of consultants for their projects. Similarly, they should also participate in the trainings and seminars organized by Consulting Engineers Association of India (CEAI). For proper selection of consultants, it is desirable to provide a Quality Cost Based Selection (QCBS) as promoted by FIDIC.

**4.4** A system of quality assurance and quality audit for the consultant's work including instituting a system of grading the firms and keeping a track record of their past performance need to be introduced. The specialized training in collaboration with academic institutions should be worked out for utilization by the consulting firms. There is need to encourage formation of joint ventures with international firms for improvement of capabilities especially in emerging technologies where domestic expertise is still lacking. Some system of performance evaluation of consultants by some independent professional agencies could be considered.

**4.5** There is also need for further growth of the consultancy sector. For this, some mechanism to consciously encourage small size and medium firms wanting to enter highway sector needs to be evolved.

**4.6** There are instances of change in personnel by the consultants on one ground or the other, although most of the consultancy agreements specify that only in unavoidable circumstances, such as on health grounds, etc., replacements by equivalent or superior personnel could be allowed. There is requirement to ensure the continuation of originally proposed team in the interest of the project.

**4.7** There is need for consultants to follow the code of ethics prescribed by the Consulting Engineers Association of India (CEAI) in letter and spirit.

**4.8** With the increased role of consultants in highway development it is anticipated that consultancy sector will draft in competent professionals to take care of various activities involved, such as, project formulation, design, supervision, quality control, monitoring etc. In view of the prevailing shortage of experienced manpower, it would be prudent to develop and train personnel to take up consultancy as a profession. It would be advisable to consider a system of sending on deputation Engineers from Government Department and state PWD's to Consultancy Companies.

## **5 Concessionaires Firms**

**5.1** The Concessionaires themselves are not expected to possess in entirety the in-house technical capabilities for developing, operating, maintaining the highway sections for the fixed tenure of the concession period. They may be allowed to mobilize the expert services and satisfactorily demonstrate and manage the availability of such services for the duration of the Concession Period. The Concessionaires may be allowed to pool up expertise (technical, financial, legal, etc.) of separate companies through contractual arrangements, etc. This would enable growth of the domestic knowledge based industries as a whole, promoting growth of separate individual companies/private institutions with dedicated expertise, rather than having single organization/company with multi-disciplinary expertise.

**5.2** The Concession Agreements should encourage promotion and use of innovative technologies/materials as generally they lay down performance criteria and final product requirements without getting into the finer technical nuances. The Concessionaires should accordingly take this opportunity to introduce not only cost-effective technologies/materials, but also try to promote more environment and ecology friendly constructions, with utilization of waste/marginal materials or industrial by-products and try to minimize depletion of natural reserves such as bitumen, aggregates etc. They would be expected to undertake innovative methods and scientific application of project management to formulate and complete the project in shortest possible time, in order to generate resources at the earliest. They should also demonstrate

commitment for proper operation and maintenance services after the highway is open for commercial operations so that quality of service to road users is maintained, and provide satisfaction to the users.

## **6 Domestic Equipment Manufacturing Industry**

**6.1** The emphasis will be required to boost the local industry for manufacturing of highway equipment. Further, the concept of “Equipment Bank” in the private sector regarding leasing of equipments needs to be encouraged, and made available to the contracting agencies. The equipment manufacturers must also respond to meet the growing volume of works by increasing their levels of production and also manufacture new range of equipments of international standards suiting to current requirements.

**6.2** There is necessity for developing low cost indigenous equipment and machinery for projects on lower category of roads such as Rural Roads etc., so that the projects could be implemented within reasonable costs and through smaller contractors. The equipment industry also needs to support the contractors with training of foremen and operators.

## **7 Need for the Restructuring of Organizations**

**7.1** Prior to 1985, for improvement of National Highways, the then policy followed for the stage construction and labour intensive construction technology which led to a thin spread of available meagre financial resources over a larger length. Therefore, in the early period the projects were implemented mainly on small and medium sized contract packages, involving contractors of lesser capacity and with the equipments which were mainly road roller and hot mix plants supplied by the Government departments. However, for bridge works, comparatively bigger contractors were available but their equipment resources were quite limited. A major push in the direction of big size project package came in 1985 when for the first time, the Government of India, while seeking loan assistance for roads from the World Bank (WB) accepted to adopt International Competitive Bidding (ICB) procedures and FIDIC conditions of contract for the highway projects, forming part of the loan package. In order to encourage modernization and mechanization, size of the projects were kept at Rs.100 to Rs.150 million at that time.

**7.2** The economic reforms introduced in 1991 gave further impetus to import of world-class road making equipment. The modifications of the MORTH specifications facilitated the use of modern equipment. After Year 2000, there has been a growth in the usage of modern equipment in the road sector, especially the projects undertaken



by NHAI. The country has seen the change in thrust in respect of the use of equipment, born out of need. The evolution in technology for the road construction has resulted in the introduction of machines like Wet Mix Plants, Pavers for the construction of base course, etc. Cold and hot milling machines, cold and hot re-cycling machines have also been introduced to reduce the thickness of the road crust and to recycle the used material for the highway construction. On the maintenance aspects the mechanized construction have been introduced in the form of pot-hole repairing machines, slurry sealing machines and sophisticated machines like kerb laying machines and line marking machines. Management of maintenance works have also evolved over the years, grounded on more rigorous scientific analysis of road net-work condition.

**7.3** The methodology of construction has progressively shifted from labour intensive system in the pre-economic reform period to the present day mechanized system. This has contributed to adoption of improved designs and specifications and speedier project implementation. However, this also demands adaptation of effective working environment and paradigm shift from prevalent institutional system of yesteryears to an institutional mechanism suiting the present day requirements. Further, with the Government's initiative to encourage implementation of more and more projects through Private Sector participation on Build-Operate-Transfer (BOT) mode, the roles of both Government organizations and Private Sector associated with development of highways have been redefined. In other words, in the light of modern technology, use of new specifications, machine oriented construction and different contracts for implementation, the implementation organizations need to be upgraded to take on the challenge of accelerated development works.

**7.4** A review of strength and weakness of the existing procedures, rules and regulations, delegation of powers, present method of implementation, forthcoming opportunities and threat from external environment may be taken up by the organizations with the aim to address and implement the needed reforms in these organizations.

## **8 Availability of Technical Professionals in the Sector**

**8.1** The present impetus of development in the Highway Sector is not adequately supported by the availability of Technical Professionals in the Sector, i.e. Engineers, Scientists, etc. This is perhaps the most disconcerting fact which may adversely affect the development of this sector in the country. Therefore, efforts are required for developing more number of experts in the Sector. With more lucrative job avenues opening up in the highway sector, the premier academic institutions should be sensitized and encouraged to induct more number of students in the discipline of Civil Engineering with particular emphasis to specializations, such as, Highway Engg., Traffic and Transportation Engg., Structural Engg., Geotechnical Engg. etc.

**8.2** The Engineering and Technical Institutions are to be encouraged and incentives given for attracting students in Highway Engineering profession. The Association of these Institutions is also required for providing training to the new entrants as well as in-service engineers.

## **9 Training of Engineers and Professionals**

**9.1** Appropriate training arrangements are required to be made for increasing the number of Highway Engineers and other professionals. It is also essential to create awareness among the highway engineers regarding the technological developments world over. The training needs, involving training in engineering disciplines, project management techniques, financial management, operation and management of highways, etc., should be imparted during entry in services, at job sites and through periodic in-service refresher courses. These are applicable for contractors and consultants. Training of engineers working in the highway sector is perhaps one of the most important area requiring attention. It has to be a continuous exercise. To keep pace with technological developments, it is essential to keep abreast of good practices in planning, design, construction management and maintenance of road and bridge projects. All concerned both government and private sectors, should formulate a training policy and decide on arrangements to network with the existing training institutions, i.e. NITHE, IITs, IIMs, CRRI, etc. for regular training of engineers at all levels. Such a policy should address the need for training at entry, on job-site, periodic in-service refresher courses and study leave/tours within the country or abroad to enhance their skills in various management and engineering aspects.

**9.2** The National Institute for Training of Highway Engineers set up by the Government of India would need to play a vital role in training effort. NITHE should also come out with a comprehensive plan indicating the various areas of training for different levels of highway engineers, duration and course contents and periodically update/modify the same as per the sectoral requirements depending upon the feedbacks obtained thereon. NITHE should also function as a repository of documentation of all major projects for future lessons learning and dissemination. NITHE may consider entering into MOUs with the international and national training/academic and research institutions to provide the institutional support. For augmenting the activities of NITHE all the departments dealing with roads should support the NITHE by sending adequate number of persons for training and also provide required finances. To serve highways sector in comprehensive manner, NITHE should be given status of a University. Besides, four more similar institutions be opened in South, West, East and North-East regions.

As required, post-graduate, graduate level, diploma and certificate courses be developed by NITHE. Besides, the training and skill development of Workmen, Supervisors and Equipment Operators should also be included in the scope of activities of NITHE.

**9.3** There is a marked reluctance on the part of many organizations, especially the State Government Organizations, to depute technical personnel for training mainly on the plea that they could not be spared on account of pressing necessities. However, a mechanism needs to be evolved to make periodic training programme a mandatory requirement for promotions, specific postings, etc. and, if necessary, the training programmes could be finalized well in time after consulting the concerned higher level authorities and taken into account the eventualities and possible exigencies, so that the person deputed for a specific training programme undergoes the same without fail.

**9.4** Respective organizations must carry out a Training Need Analysis (TNA), of their employees taking into account the competence level required for the job and the employee data. Periodic training rosters should be prepared and needs to be followed for effective results. The human resource department of the organization must look at the training aspects as an important ingredient of their activity. In order to assist the organizers and individuals for training of their professionals, IRC is publishing a document and placing on its web site, for giving information about available training facilities and calendar of training programme being run by various institutions and organizations. This will help in selecting training required by professionals for their specialized needs.

## **10 Training and Certification of Supervisors and Workmen**

**10.1** According to Government estimate, included in the National Employment policy, around 457 million people in labour force need to acquire new skill standards or upgrade their skills. Current capacity of the government run Technical Vocational Education Training Programme is only 12.2 million each year, whereas, 12.8 million work force is added every year. It is found that only 5 percent of youth between the age group of 20-24 possess vocational skills, while this figure is 28 percent in Germany, 79 percent in Canada and 80 percent in Japan. Most of the labour force employed by the highway sector comes from un-organized sector, whereas, Government programmes are mostly focused on organized sector, making skill development and certification need for the highway sector a priority policy input area.

**10.2** Training is, therefore, required at the cutting edge level of technicians, supervisory staff of road agencies and contractors' workers—both skilled and



unskilled. Two to three ITIs in each State may be identified where such training can be imparted. National Academy of Construction in Hyderabad is a very good initiative of the Government of Andhra Pradesh with the support of the Contractors. This is an example, worthy of emulation by other States.

## **11 HRD is Organizational Requirement**

**11.1** For effective and efficient plan formulations and project implementation it is vital that there is congruity of purpose among all concerned organizations. Convergence of their aims and objectives however requires that the activities of all the varied functionaries working in different organizations, departments, agencies, institutes, laboratories etc. are cumulatively found reinforcing the realization of road map prepared for the highway sector development. This calls for creating a synergy among various stakeholders associated with Highway Development, viz. the Planning and Funding agencies at the Government level, implementation agencies at the Govt. level, Contractors/Concessionaires, Consultants/Independent Engineers, Equipment manufacturers, suppliers of other materials, suppliers/manufacturers of various patented products relevant to the sector. This mutually reinforcing synergy is required for the promotion of a conducive environment and good work ethos. Fourth Road Development Plan has laid emphasis on the capacity building of various stockholders' organization which among others includes strengthening of decision support system by way of stronger database development, specialization of professionals, re-engineering of organization for sound decision making, synchronization of working in the organizational set up and development of skilled man power.

**11.2** At the turn of Century, the highway sector in India is facing challenges, not witnessed at any time in the past. The highway sector is poised for fast development and it has already taken quantum jump with regard to availability of funds. Accordingly physical targets are being set and sought to be achieved with the expectation of international standards. All the agencies are aware of challenges ahead. However, the critical review of capability and capacity of different organizations and agencies reveal the hard fact that they need capacity building and re-structuring at the organizational level and enhancing professional capability and skills of individual working in different organizations dealing with highway sector. It is, therefore, necessary that capabilities of human resources are enhanced, so that challenges ahead can be faced with full preparedness. It is to be realized that any organization finally depends for its growth and sustenance on those who make up the organization. For this purpose, Human Resource Development (HRD) has to be given serious consideration and prominent place in organizational functioning.

## CHAPTER 7

# HR AND HRD SPECTRUM

### 1 HRD is Organizational Requirement

In the past the subject of Human Resources Development had always drawn attention by many philosophers, social scientists and thinkers. In the recent past, the modern trend in HRD has brought out new concepts, which are unparalleled. It is therefore, considered necessary to briefly present latest trends in HRD and HRM so that different organizations can study and adopt these trends.

### 2 Human as Resources

2.1 The notion of human as resources for the purpose of HRD subsumes three conditions. First is 'Employability' that is need of the people to acquire basic competencies that are of value in the marketplace as well as within the organization. It acknowledges that both individual and organizations have a responsibility to develop generic competencies. Second is the demonstration of 'entrepreneurial behavior' by the organizations and for the individuals to take responsibility for their 'own show' within an organizational setting. Third, the employees are expected to interact with others and demonstrate effective 'team work' alongside demonstration of individuality and 'added value' to the organization. In the context of HRD 'Development' means growth, continuous acquisition and application of one's skill. The concept of Development of human resource is, therefore in the context of organizations lie in harnessing employee's resource attributes like knowledge, skill, and attitude by the organizations for its own growth and development. The growth and development of organization through the development of its human resource in a manner which is both harmonious and mutually reinforcing is subject matter of HRD. In this way, Human Resources become central to organization. Today, they have acquired even more central role in building sustainable competitive advantage for the organizations as the world moves towards borderless economies.

### 3 Defining the HRD

3.1 All the three words namely 'human' 'resource' and 'development' being generic and broad in assuming their meaning, defining HRD is not an easy task. Most definitions however recognize the value of human expertise and the responsibility of utilizing that expertise. At a macro level, HRD as a process or an activity functions as an agent for societal development.

**3.2** HRD is both an area of professional practice and an emerging interdisciplinary body of knowledge aimed to meet some social and organizational need. HRD is about learning and that learning is something which occurs within an individual to cause development. According to one of the definition, HRD encompasses the study and practice of increasing learning capacity of individuals, groups, collectives and organizations through the development and application of learning based interventions for the purpose of optimizing human and organizational growth and effectiveness. The HRD thus includes all those activities and process that improves employee's knowledge, expertise, productivity and satisfaction with a shared belief that such activities or process will benefit the organization. Such improvement in employees' knowledge, expertise, productivity and satisfaction is brought about by learning based interventions. Such learning experience according to Nadler, should however be conducted in a definite time period to increase the possibility of improving job performance and growth. Such learning experience must be 'organized' that is conducted in a systematic way. Learning can be incidental or haphazard but organized learning can only be imparted through a system of training so that learner can attain clear and concise standards of performance or objectives. Such organized training must be conducted in a definite time period that is the amount of time, the learner will be away from work and must be determined and specified at the onset of the training programme. Training for the purpose of understanding HRD, subsumes a planned process which is undertaken to modify attitude, knowledge, or skills through learning experience to achieve effective performance in an activity or range of activities. In other words, through training, knowledge is transferred and put to practice. Knowledge is transformed into learning experience. It brings relatively permanent change of knowledge, attitude or behavior. Unleashing of human expertise through such organized learning and training for the purpose of improving performance at individual, group and organizational level thus become the ultimate objective of HRD.

#### **4 Linking People with Organization**

There are three main areas with which human resource development is involved, namely individual, occupational and organizational development. These identify the three major areas in which T&D requirements occur within an organization. At individual development level HRD covers areas such as skill development, interpersonal skills, career development etc. T &D needs at group and occupational level covers integrating cross-functional workers through team building program, training employees about new product or services etc. Such T&D activities at organization level may involve introduction of new culture or way of working. Total Quality Management is one such intervention at organizational level in which all groups and individuals are involved.



## 5 HRD and HRM Sector

**5.1** Both Human Resource Development (HRD) and Human Resource Management (HRM) deal with Human Resource (HR) within the context of organization's functioning. HRM is all about systematically linking people with the organization. Management of HR is integrated into strategic decision making process that directs organizational efforts towards coping with the environment. As a body of ideas HRM asserts critical relationship between environment, overall business strategy and human resource strategies. HRM practices include HR planning, recruitment, selection, training, development, placement, rewards, compensation, retention, career planning, succession planning, and evaluation and promotion of personnel within organization. Major activities of HR functions include organizational design, staffing, employees and organizational development, performance appraisal and management, reward system and benefits, productivity improvement, employer-employee relationship, industrial relations and health and safety. Training and development of employees which is central focus of HRD activities are positively related to strategic HRM variables. HRM policies may create an environment which may encourage or discourage HRD activities of an organization. Thus, HRD in an organization is an important part of macro-level strategic HRM. Good HRM practices leads to improved HRD variables as reflected in increased work motivation by the employees, initiative, and commitment towards the organization which in consequence lead to improved efficiency, productivity and higher organizational performance. Training and development as a part of HRD are key interventions made in order to address skill deficiencies and to add value to human capital. Sound HRD practices thus emphasize on strategic training system to match skill development for organization's need, personal development and growth within an organization whereas HRM focuses on the management aspect of HR as a part of overall strategic management of the organization.

**5.2** The following five areas incorporate elements of both HRD and HRM which have significant degree of overlap:

- i) *Organizational Design*: The primary purpose of this area is to integrate the human operations, organizational structure and system for the delivery of products and services in an effective and economic manner. There are five areas of personnel contributing to organization design. (a) The operating core; the employees who undertake the delivery of products and services; (b) The strategic apex; high level managers who have organizational responsibility; (c) The middle line; the managers who link the strategic apex and the operating core; (d) The techno

structure; Subject specialists supplying specialized services and (e) The support staff; people providing indirect support for the other elements of the organization.

- ii) *Job Design*: Each job should have a clear role within the overall organizational structure. If organization is designed having to require integrating different roles and work tasks, then job design is the process of identifying the range and scope of a particular job and the degree of output from them.
- iii) *HR Planning*: The main purpose of this area is to assess the HR requirements of the organization. It will also include developing strategies for achieving appropriate staffing level.
- iv) *Performance Management*: Assessment of personal performance feeds into career development, compensation and promotion, movement within the organization and sometimes even termination of employment. It links performance of an employee with the objectives of the organization and is carried out through mechanism of appraisal system.
- v) *Recruiting and Staffing*: The inflow and outflow of people within an organization is a dynamic process and needs to match the requirement of the organization within its operating environment. T&D supports this process by ensuring that the staff entrusted with the recruitment and selections have necessary skills to enable them to successfully recruit and deploy people throughout the organization.

## 6 HRD and OD Sector

Organization Development (OD) is the applied behavioral science discipline dedicated to improving organization and the people in them through the use of theory and practice of planned change. OD is a process for teaching people how to solve their problems, take advantage of opportunities, and learn how to do better and better over time. OD focuses on issues related to 'human side' of organization by finding ways to increase the effectiveness of individual, team and organization's human and social process. Organizational culture processes, and structure captures the essence of OD. OD programs as a process delineates identifiable flow of interrelated events moving over time towards the goal of organizational improvement and individual development. It seeks bring about fundamental changes in organization's culture. Important processes in the organization includes communication, problem solving, and decision making,

HR practices, resource allocation, conflict resolution, allocation of rewards, strategic management, exercise of authority, and self renewal or continuous learning. OD focuses on improving organizational processes. In short OD programme is to optimize the system by ensuring that the system elements are harmonious and congruent. OD thus become an effort which is planned, organization wide and managed from the top to increase organizational effectiveness and health through planned interventions in the organization's process using behavioral-science knowledge. Both HRD and OD have performance improvement as one of the desirable goal or purpose. Many behavioral theories of OD practices can be gainfully utilized by HRD practitioners for performance improvement. Transition Theory for example, may inform HRD professionals about how individual cope with change. Understanding how individual cope with change may explain why, after change interventions, individual performance often decreases before it improves. To workout methodology for HRD, it is absolutely necessary to understand various terms used for HR studies.

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## CHAPTER 8

# HRD TERMINOLOGY AND THEIR LINKAGES

### Introduction

Without proper understanding the concepts of HRD terminology like learning, training, development, knowledge and performance etc. and an informed means of selecting them, there is likelihood that stakeholders' may not be able to replicate the results or develop a deep understanding of results they want to achieve. HRD definitions uses different concepts depending upon how the HRD is looked upon by the experts, firms or organization; whether HRD is located on the locus of an individual, group, process, organization, society or on still bigger entity like humanity as a whole. Nevertheless most definitions recognize the value of human expertise and the responsibility of utilizing that expertise. Such unleashing of expertise is for the purpose of improving performance at individual, group, process, and organization level and such performance improvement is directed towards organization's intent. The ultimate aim of HRD being performance improvement, the linkages between various concepts and sub-concepts can be understood only by locating them in respect to performance.

In any given learning environment, depending upon the learning style, a trainee or learner receives new inputs which are first absorbed by him. He forms concepts and framework based on his experience and tests new situation. In this stage he gains knowledge. In the next step, learner gets into a phase of active learning by 'doing' where he manipulates his experience to new situation. He develops 'skills' in this phase of learning. These skills are then reinforced through 'interaction' where learner shares his newly acquired behavior or skills with his peer group through questioning, modeling or discussion. He develops 'depth and insight' into his learning experience. He becomes trained. In the next phase learner puts his newly acquired skills into practice to deal with new situation. He develops new metaphors and re-frames his experience. He gains wisdom. This newly acquired skills and attitude puts him on expected level of performance which is the ultimate objective of any training and development programme. Three main component of HRD programme are Training, Development and Education. 'Training' component of HRD is that aspect of learning which is meant for the present, 'Education' is for future and 'Development' is to lead. Although some organizations club all learning under 'Training' or 'Training and Development,' dividing it into three distinct categories makes the desired goals and objects more meaningful and precise. Various terms generally used in the training

and development program however needs to be understood properly to enable client, consultant or contractors to implement T&D program in their organization which will be effective and long lasting in transferred knowledge and skills to the trainees. These are briefly described in this chapter.

## 2 Learning

**2.1** Learning has been defined as a relatively permanent change in behavioral potentiality that occurs as a result of reinforced practice. Learning has also been defined as 'the process by which people acquire new skills or knowledge for the purpose of enhancing performance'. Learning can be 'incidental' or 'intentional'. Incidental learning is considered to be learning which occurs during course of doing other things such as reading, talking with others, traveling, etc. Learning has limited value unless it is put into practice where it becomes 'intentional'. Learning cannot be guaranteed and that it is only a possibility of learning which may happen. According to John Ruskin 'What we know, or what we think, is in the end of little consequence. The only consequence is what we do'.

**2.2 Learning Domain:** Learning can be interpreted in three ways (a) To get to know something which was earlier not known (b) To learn as in to memorize by heart like standard activities drill during emergency situation (c) Learning as a change, which can be either reinforcement or alteration of certain ideas or behavior. Learning can be either active or passive. Traditional approach to learning is based on passive learning, where teacher is considered as the expert of subject matter and pupil is seen as the recipient of that expertise. There are generally five domain of learning (i) New 'knowledge' where information is largely memorized. (ii) Process of organizing and reorganizing knowledge to create new pattern and relationship. (iii) Abilities to do certain things like skills of thinking, skills of new learning, skills of coping and solving problems and survival strategies. (iv) Learning of desired attitude. (v) To carry out new learning into changed 'ways of behaving' i.e. to attain 'wisdom'. Learning can be divided it into three major domains namely Cognitive, Affective and Psychomotor befitting the learners skills and knowledge background. These three domains are then divided into other learning processes. They are then plotted with the three main areas of HRD- training, development, and education as illustrated in **Annex-1**

**2.3 Learning Style:** Each learner has different style of learning and to that extent each learner is unique. Learning style is a learner or student's consistent way of responding to and using stimuli in the context of learning. A few of them are as follows:

**2.3.1** *David Kolb's learning style:* According to Kolb, the learning cycle involves four processes that must be present for learning to occur. They are (i) Activist- It involves active experimentation like small group discussions, feedback. In this, trainer leave learner to determine his/her own criteria for the relevance of material. (ii) Reflector- It involves reflective observations like study of journals, brainstorming. In this process, trainer provides expert interpretation. (iii) Theorist- It involves abstract conceptualization by going through and relating the lectures, papers, analogies to the learning. Trainer in this approach provides case studies, theory reading for learner to think and conceptualize the issue. (iv) Pragmatist- It calls for concrete experience like laboratory and field observations. Here trainer is a coach and learner is autonomous learner through observations, peer feedback etc.

**2.3.2** *VAK learning styles:* The VAK learning Style uses the three main sensory receivers - Vision, Auditory, and Kinesthetic (movement) to determine the dominant learning style. Learners use all three to receive information. However, one or more of these receiving styles is normally dominant. This dominant style defines the best way for a person to learn new information by filtering what is to be learned. This style may not always to be the same for some tasks. The learner may prefer one style of learning for one task, and a combination of others for another task. As a matter of practice, a good trainers presents information using all three styles. This allows all learners, no matter what their preferred style is, and an opportunity to become involved. It also allows a learner to be presented with the other two methods of reinforcement. Using combination of VAK, a learner can be helped to learn even faster as learner has more than one reinforcing material. Some hints for recognizing and implementing the three styles are (a) Auditory learners often talk to themselves. They also may move their lips and read out loud. They may have difficulty with reading and writing tasks. They often do better talking to a colleague or a tape recorder and hearing what was said. To integrate this style into the learning environment it is suggested to (i) Begin new material with a brief explanation of what is coming and conclude with a summary of what has been covered. Open up the lecture session by questioning learners to draw as much information from them as possible and then fill in the gaps by the trainer using his own expertise.(iii) Include auditory activities, such as brainstorming, questioning and answering among learners.(iv) Leave plenty of time to debrief activities. This allows learners to make connections of what they have learned and how it applies to their situation. (v) Have the learners verbalize the questions. (vi) Develop an internal dialogue between trainer and the learners. (b) Visual learners have two sub-channels - linguistic and spatial. Learners who are visual-linguistic, they like to learn through written language, such as reading and writing tasks. They remember what has been written down, even if they do not read it more than once. They like to write down



directions and pay better attention to lectures if they watch them. Learners who are visual-spatial usually have difficulty with written language and do better with charts, demonstrations, videos, and other visual materials. To integrate this style into the learning environment it is suggested to (i) Use graphs, charts, illustrations, or other visual aids. (ii) Include outlines, agendas, handouts, etc. for reading and taking notes. (iii) Include plenty of content in handouts for re-reading by the learners after the learning session. (iv) Leave margin space in handouts for note taking. (v) Invite questions to help them stay alert in auditory environments. (vi) Emphasize key points to suggest when to take notes. (vii) Eliminate potential distractions. (viii) Supplement textual information with illustrations whenever possible. (ix) Show diagrams and then explain them. (c) Kinesthetic learners do best while touching and moving. It also has two sub-channels - kinesthetic (movement) and tactile (touch). They tend to lose concentration if there is little or no external stimulation or movement. When listening to lectures they may want to take notes. When reading, they like to scan the material first, and then focus in on the details. They typically use color highlighters and take notes by drawing pictures, diagrams, or doodling. To integrate this style into the learning environment, it is suggested to (i) Use activities that get the learners up and moving. (ii) Use colored markers to emphasize key points on white boards. (iii) Give frequent stretch breaks (brain breaks). (iv) Give learners something to do with their hands. (vii) Provide highlighters, colored pens and/or pencils. (ix) Guide learners through a visualization of complex tasks. (x) Have them transfer information from the text to another medium such as a keyboard or a tablet.

**2.3.3 Multiple intelligences learning style:** There are multiple intelligences, and that one uses for the most effective learning. According to this theory 'multiple intelligences' include the following: (i) Verbal Linguistic intelligence (sensitive to the meaning and order of words as in a poet). It uses activities that involve hearing, listening, impromptu or formal speaking, tongue twisters, humor, oral or silent reading, documentation, creative writing, spelling, journal, poetry etc. (ii) Logical-mathematical intelligence (ability to handle chains of reasoning and recognize patterns and orders as in a scientist). It uses activities that involve abstract symbols/formulas, outlining, graphic organizers, numeric sequences, calculation, etc. (iii) Musical intelligence (sensitivity to pitch, melody, rhythm, and tone as in a composer). It uses activities that involve audio tape, music recitals, singing on key, environmental sounds, percussion vibrations, music composition, etc. (iv) Spatial intelligence (ability to perceive the world accurately and tries to re-create or transform aspects of that world as in a sculptor, painter, or architect). It uses activities that involve art, pictures, sculpture, drawings, doodling, mind mapping, patterns/designs, color schemes, active imagination, imagery, block building etc. (v) Bodily Kinesthetic intelligence (ability to use the body

skillfully and handle objects adroitly, as in an athlete or dancer). It uses activities that involve role playing, physical gestures, drama, inventing, physical exercise, body language etc. (vi) Interpersonal intelligence (understanding people and relationship as in a salesman or teacher). Using this intelligence learners think by bouncing ideas off to each other. It uses activities that involve group projects, division of labor, sensing others' motives, receiving/giving feedback, collaboration skills etc. (vii) Intrapersonal intelligence (possessing access to one's emotional life as a means to understand oneself and others and exhibited by individuals with accurate views of themselves). It uses activities that involve emotional processing, silent reflection methods, thinking strategies, concentration skills, higher order reasoning, meta-cognitive techniques etc. (viii) Naturalist (ability to connect to the intricacies and subtleties in nature such as Charles Darwin, Isaac Newton). It uses activities that involve bringing the outdoors into the class, relating to the natural world, charting, mapping changes, observing wildlife, documenting star's movements, keeping journals or logs.

### **3 Training**

**3.1** Training is the acquisition of technology which permits employee to perform their present job to standards. Training is 'that organized process which is concerned with the acquisition of capability or the maintenance of capability'. It improves employee's performance on the job in hand. Training is also imparted for equipping the employee to handle new machineries, technologies or processes. A person's performance is improved by showing him how to master a new or established technology. The technology may be a piece of heavy machinery, a computer, a procedure for creating a product, or a method of providing a service. It will be seen that as per the definition, training is provided for the present job. This includes training new personnel to perform their job, introducing a new technology, or bringing an employee up to standards. In any system, there are four inputs namely: people, material, technology, and time. Output of such a system can be a product or service. Training is mainly concerned with the meeting of two of these inputs -- people and technology where people uses technology to transform the material input into a tangible output in certain prescribed fashion.

### **4 Development**

**4.1** Development means growth, continuous acquisition and application of one's skill. Development thus becomes a part of lifelong learning experience. Continuous acquisition of new viewpoints, new horizon and technologies makes the employee proactive rather than reactive. It enables the employee to create better product and faster services. Unlike training and education, development cannot always be fully

evaluated since development is learning for growth of the individual and not related to any present or future job. Development being associated with the creativity, innovation and application of skills, it is one of the prime mover of providing competitive edge to the organization. It is in the forefront of what many now call the 'Learning Organization'.

**4.2** Development involves changes in an organism that are systematic, organized, successive and are thought to serve an adaptive function. Training on the other hand makes the organization more effective and efficient in its day-to-day operations. Development is different from 'change' which refers to alterations that occur over a period of time in learner's internal cognitive or affective characteristics. This change may be quantitative or qualitative, and implies no directionality, encompassing both regression and progression. Unlike training, which can be fully measured, development cannot always be fully evaluated due to the complexity of the skills received and used. Good development programs however affect an organization's climate and culture, which can give an organization a competitive edge. Due to vagueness of data, development program requires lot of skill and innovative approach by the trainers. The measurement of these programs is often attitude surveys which are performed before and after implementation. Since attitudes often change on a day-to-day basis, several surveys have to be performed throughout a given period.

## **5 Education**

**5.1** Education is training people to do different jobs or to increase their potential. Unlike training which can be fully evaluated after the training program, complete evaluation of education is possible only after the learners use the education generated potential on their new assignment. Effectiveness of education is generally reflected in the efficient performance of new assignment or job. Education is transfer of knowledge to the learner to enable them to take up new assignments. It is often given to people who have been identified as being considered for a new job either lateral or upwards, or to increase their potential.

## **6 Knowledge**

**6.1** Knowledge is the perception of the agreement or disagreement of two ideas. It is a fluid mix of framed experience, contextual information, values and expert insight that provides a framework for evaluating and incorporating new experiences and information. The role of knowledge in generating appropriate actions is that it serves as a background for articulating possible courses of action (articulation), for judging whether courses of action will yield the intended result and for using this judgment in



selecting among them (selection), for deciding how actions should be implemented and for actually implementing actions (implementation).

**6.2      *Explicit and Implicit Knowledge:*** There are two types of knowledge (a) Explicit knowledge: It is the type of knowledge that can be transformed into formal language, including grammatical statements (words and numbers), mathematical expressions, specifications, manuals, etc. Explicit knowledge can be readily transmitted to others and also can easily be processed by a computer, transmitted electronically, or stored in databases. Explicit knowledge can be 'rationalized knowledge' which is general, context independent, standardized, public and readily sharable in the organizational environment like knowledge of engineering design manual which is freely available and can be shared in the organization or it can be 'embedded knowledge', which is context dependent, narrowly applicable, personalized and may be personally or professionally sensitive and not easily sharable among the individuals. (b) Tacit knowledge: As word suggests it is the knowledge which is embedded in individual experience and involves intangible factors, such as personal beliefs, perspective, and the value system. Tacit knowledge tends to be sticky in nature and therefore requires incremental expenditure in moving knowledge in a form that is useable and easily understood by the information seeker. Tacit knowledge is thus hard to articulate with formal language. It contains subjective insights, intuitions and hunches. Before tacit knowledge can be communicated, it must be converted into words, models, or numbers that can be understood. There are two dimensions to tacit knowledge (i) Technical Dimension or Procedural: This encompasses the kind of informal skills often captured in the term know-how. Highly subjective and personal insights, intuitions hunches and inspirations derived from bodily experience fall into this dimension. (ii) Cognitive Dimension: This consists of beliefs, perceptions, ideals, values, emotions and mental models so ingrained that they are taken for granted. Though they cannot be articulated very easily, this dimension of tacit knowledge shapes the way one perceives the world around him.

**6.3      *Knowledge Conversion:*** There are four modes of knowledge creation or conversion that are derived from the above mentioned two kinds of knowledge (i) Socialization: It is transfer from tacit to tacit and includes socialization process like observation, imitation, and practice. (ii) Internalization: It is transfer from explicit to tacit and includes activities of internalization like 'learning by doing' or visualization. (iii) Externalization: It is transfer from tacit to explicit and includes process of transfer using metaphor, simile, models etc. (iv) Combination: It is transfer from explicit to explicit and involves process of systemizing concepts into a knowledge system through media, such as documents, meetings, and conversations. Information is reconfigured

by such means as sorting, combining, and categorizing. Formal education and many training programs work using combination.

## **7 Understanding Continuum**

**7.1** Understanding is a cognitive process which transforms the data, and other sensory inputs, into higher level of value added output like information, knowledge and wisdom. Without understanding there cannot be any knowledge generation. One gains knowledge through context (experiences) and understanding. When one has context, one can weave the various relationships of the experiences. The greater one understands the subject matter, the more one is able to weave past the experiences (context) into new knowledge by absorbing, doing, interacting, and reflecting.

**7.2** In this continuum-data, information, knowledge and wisdom can be considered as a pyramid. In this pyramid, base is data which consists of images, sound, digital transmission etc. They however have little value unless they are interpreted by structuring, filtering or summarizing and converting them into some kind of information. Information so generated then becomes contextualized which can be transmitted or presented through media like lecture, text or internet. This information when operated upon by the individual using his experience and processed through absorbing, doing, interacting and reflecting, is transformed into knowledge. Knowledge has the complexity of experience, which come about by seeing the information from different perspectives. The reason knowledge emphasizes on personal interpretation and understanding, training and education become difficult. One cannot count on one person's knowledge transferring to another. Knowledge is built from scratch by the learner through experience. Information is static, but knowledge is dynamic as it lives within a person.

**7.3** Information is 'flow of messages' whereas knowledge is created when this flow of messages interact with the 'beliefs and commitment of its holders'. Wisdom is located at the apex of pyramid. When knowledge is combined with intuition and experience it is often called wisdom. One of the outstanding examples to illustrate understanding continuum is the work of Tycho, Kepler and Isaac Newton in the field of science. Tycho, using his telescope, provided clear, well defined observational data especially of celestial movement of Mars. Tycho provided the first step of data based on accurate observations. Kepler took the second step of re-arranging the data and created sense out of these data. In the third step Kepler created order out of enormous volume of data by laying down three simple laws of planetary movements which were easy to understand. The knowledge input from Kepler was further extended and given a universal dimension by Isaac Newton who explained that three simple laws of Kepler

were merely offshoot of a more fundamental inverse square law. Wisdom of Newton converted laws of planetary movement into the universal law of gravitation.

## 8 Performance

**8.1** Performance is focused behavior or purposeful work. In other words, jobs exist to achieve specific and defined results (outputs) and people are employed so that organizations can achieve those results. This is performed by accomplishing tasks. Performance has two aspects -- behavior being the means and its consequence being the end. Managing performance has the dual purpose of (a) arranging situations (environment) so that employees can do their best and (b) growing the employees by educating, enlightening, and appreciating them. Its purpose is to achieve specific and defined results from people so that the organization can achieve its goals and objectives. It is much easier to fix situations by making structural changes to the organization by adopting strategies like changing reporting relationships, enlarging the job, improving a process, or opening lines of communication. It is however much difficult trying to change people which has to be brought about through complex interplay of many behavioral concepts. An emphasis on the performance improvement is critical to the credible practice of HRD as there is increasing demand in organization for high performance. The increasing demand of performance outcomes requires that areas of HRD practice should develop principles and models based on performance to prevent trial-and-error application. Once performance barriers have been removed, employees can be educated, enlightened, and appreciated. This assumption is based on the premise that most employees try to do their best. They prefer harmony over conflict, action over inaction, and productivity over delays.

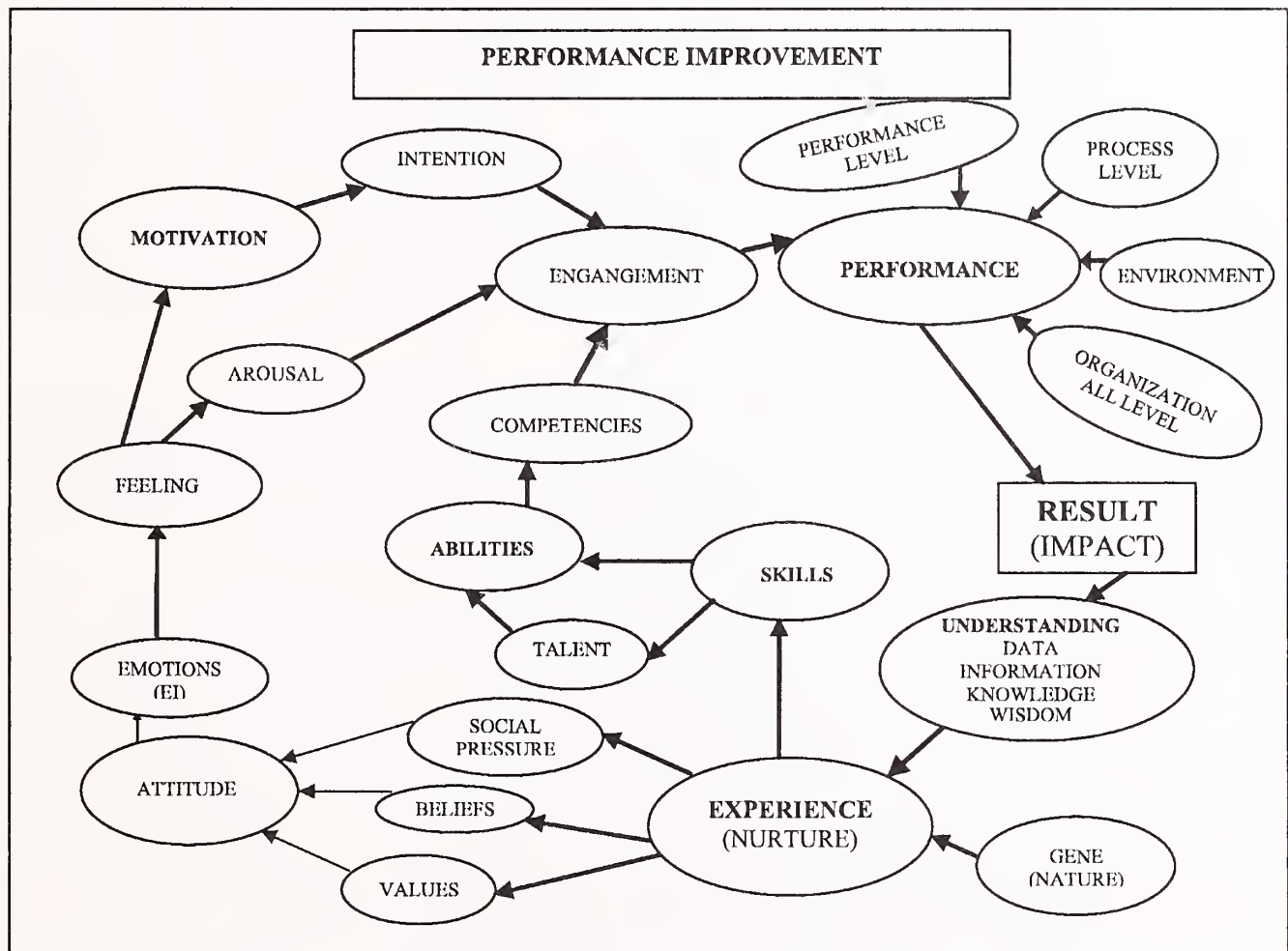
**8.2** **Performance Gaps:** A performance gap is the behavioral area not performed to standards when measuring task performance. Some performance gaps are quite easy to measure. For example, if the acceptable performance is that Schedule of quantities for the tender should be prepared in one week and it takes two weeks then there is a performance gap. If the quantity surveyor could not work out the quantity calculations then it is training problem. But if the quantity surveyor knows the job but did not do it, then it is some other type of performance problem besides training. Some of the more difficult tasks are to train and measure which are called 'soft skills', which include the affective domain such as feelings, values, appreciation, enthusiasms, motivations, and attitudes. These traits are not observable therefore, a representative behavior must be measured. For example, we cannot tell if a worker is well motivated by looking at him, but we can observe some representative behaviors, such as being on time, working well with others, performing tasks to standards, etc.



**8.3        *Measuring Performance Gaps:*** In a performance analysis, subtracting the present job performance behavior (B) from the standards (S) gives performance gap (G) and is  $S - B$ . This measurement,  $S - B$ , becomes the span that must be bridged in order to reach the objective. Once the performance gap is found to exist, then this gap is to be fitted in various levels of organization by doing 'performance analyses'. Need analysis at organizational, occupational and individual level which will inform the action to be taken at different levels of organization and corresponding evaluation at different levels for checking the effectiveness of action taken.

**8.4        *Performance Improvement (PI):*** Performance improvement intervention can be at three levels i.e. at organization level, process level, or at performer level. In this three level framework, performance improvement has three components namely goals, design and management. These three components operate at organization (goal), process (design) and individual levels (management) generating a matrix of 9 cells. At organizational level, Performance Improvement interventions can be in the form of 'organization goals' which are strategic in nature and include product and services, market (customer), competitive advantage, and priorities or in the form of 'organization design' that looks at the flows among major groups of the organization rather than activities or in the form of 'organization management' which is conducted by managing goals and sub-goals, managing performance, managing Resource (people, equipment, and capital) and managing interface (transition space between various functions or business units). At Process level, Performance Improvement aims at improving series of steps designed to produce a product or service. It should be seen as a value chain, that is, each step in the process should add value to the proceeding steps. Output minus input of any system is the process value addition. Process level is considered the pivotal link between organization and individual performance. This level usually offers the greatest opportunity for improvement. Outstanding employees cannot improve their performance levels if poor processes are in place. Performance Improvement Interventions at process level will cover 'Process goals' which is setting goals for each process activity and will be derived from the organization goals, customer requirements, and benchmarking information; 'Process design' which is designing the process structure along a logical and streamlined path; and 'process management' which is managing the process goals and sub-goals through performance management. At Job/Performer Level, goals need to be directed towards process contributions by individual. If capable, well-trained people are placed in a setting with clear expectations, minimal task interference, reinforcing consequences, and appropriate feedback; then they will be motivated. People make processes work and therefore their Job design looks at factors like ergonomics, sequence of activities, job procedures and allocations of responsibilities.

**8.5 Performance Typology:** Performance typology indicates the relationship between various facts, concepts, process and procedures which affect the observable behavior or performance. Performance improvement being the ultimate objective of T&D activity, it is essential to address various factors which contributes to the process of learning leading to desired level of performance. Various concepts used in the typology are explained briefly in alphabetical order.



Performance Typology

- a) **Abilities:** Abilities are general human capacities related to the performance of tasks. They develop over time through the interaction of heredity and experience, and are long lasting. The main difference between a 'competency' and 'ability' is that competencies require continuing education opportunities to maintain and they may disappear over time if not used. While abilities may also 'grow' over time but they are more permanent in nature.

- b) *Arousal*: Arousal level can be thought of as how much capacity is available for one to work with. The concept of arousal is closely related to other concepts such as anxiety, attention, agitation, stress, and motivation. According to 'Yerkes-Dodson law' there exists an inverted U-shaped function between arousal (x-axis) and performance (y-axis). A certain amount of arousal can be a motivator toward change or learning. But too much or too little of arousal will work against the learner. Some mid-level point of arousal provides maximum motivation to change (learn). Too little arousal has an inert affect on the learner, while too much has a hyper affect. There are optimal levels of arousal for each task to be learned. For kinesthetic tasks involving standard drill of activities demanding endurance and persistence like in military training, high level of arousal yields better result. But in cognitive tasks like solving a mathematical problem, lower level of arousal will be more effective.
- c) *Behavior*: Behavior is the manner in which a thing acts under specified conditions or circumstances or in relationship to other things. Behavior is the outcome of an internal struggle among many mental models that are defined by other people's behavior.
- d) *Attitude*: A person may have the competency to perform a task, that does not mean he or she will have the desire (attitude) to do so correctly. In other words, competencies give ability to perform, while attitudes give desire to perform. Attitude involves measuring people, issues, objects, etc. along a dimension ranging from positive to negative. This "measurement" has two components (a) cognitive and (b) affective. Beliefs and values of a person combined with his cognitive components (affective and cognitive) supply him his long range or persistent measurements for dealing with the world. Attitude quite often changes with various events in a person's life. These emotional changes also vary in length of time. It may be noted that attitude subsumes a variety of 'self concepts,' such as values, feelings, emotions, motivations, etc. The acquiring of new SKAs through a system of T&D thus involves acquiring of new values, feelings, emotions and motivation.
- e) *Attitude change performance interventions*: There are three main methods used for changing attitudes in performance interventions (a) Intavation Exposure Effect- This technique uses imparting 'positive experience' by exposing a person to a concept, object, or person a



number of times for his desired attitude formation. For example, exposing a person to timely attendance in office by his peer group is likely to supply him positive experience and without any verbal direction he may start attending office in time. (b) Reinforcement- This concept is based upon 'classical conditioning' and 'operant conditioning'. Classical conditioning is involuntary reflexes, while operant conditioning is based upon voluntary behavior. For example, making lecture hall well lighted, attractive and non-threatening is classical conditioning. Operant conditioning is based upon the premise that people repeat a behavior that gives desirable results, for example, saying a few good words or patting every time a good job is done is more likely result in a desirable behavior. (c) Persuasive Communication- This technique uses multiple reinforcement of designed concepts, images etc. like in advertising industry for bringing about desired attitude change. The advertisement industry is based upon this technique to persuade people through both their cognitive and emotional sides to buy their product.

- f) *Belief*: Beliefs are assumptions or convictions that a person holds to be true regarding people, concepts, or things. Values and beliefs are the internal force whereas norms, both formal and informal are the external force which guides the conduct of the people. The value and belief system gives a person his world view and power of knowledge.
- g) *Competencies*: Competence is the state or quality of being adequately or qualified to perform a task. A person gains competency through education, training, experience, or natural abilities. Competency has two components (a) they are observable or measurable skills, knowledge, and abilities (SKAs) (b) They must distinguish between superior performers from the other performers. In the traditional job-based organizations, the organization design is built around the job structure. The performance management of such organizations focuses on job analysis to identify job-related tasks, which are then used to identify a list of SKAs that are required for successful job performance. In the competency-based models, 'performance indicators' of 'expert performers' are developed to produce a list of grouped competencies, related to effective or superior performance. In this model, it is not SKAs which are believed as required for performing a job (as in job-based model) but which SKAs do superior performers in a job possess and use. There are four level of competencies. (a) Unconscious incompetence-

organization, group or individual not knowing what they do not know (b) Conscious incompetence- finding in a learning process something which one does not know (c ) Conscious competence- acquiring knowledge and skills through learning and training (d) Unconscious competence- total absorption of skills as to make action almost involuntary.

- h) *Culture*: Culture is what sets people free from their nature. Culture may be high art, discernment and taste or ritual, tradition and ethnicity.
- i) *Engagement*: When 'engaged', employees utilize their natural talents. They provide an instant and constant competitive edge. Engagement reflects loyalty, productivity and employee's psychological commitment to their roles. There are four levels of engagement (a) Physical energy - engaging the body (b) Emotional energy - engaging the heart (c) Mental energy - engaging the mind (d) Spiritual energy - engaging the spirit. When the employee's values and beliefs are aligned with those of the organization, they are said to become 'engaged'.
- j) *Environment*: Environment is an envelop or surrounding encompassing the process or activities. There are two types of environment, 'Internal' and 'external'. Internal environment is the surrounding area in which the front line (employees) performs their work. It includes ergonomics (design of work area), processes, equipment, and the immediate surrounding structure. Organization's output which can be products or services is then delivered to 'receiving system' or market place. The receiving system of organization's output is 'external environment'.
- k) *Emotional intelligence (EI)*: Emotional Intelligence (EI) is the 'abilities such as being able to motivate oneself and persist in the face of frustrations; to control impulse and delay gratification; to regulate one's moods and keep distress from swamping the ability to think. EI has three aspects of human nature (a) A general quality of human beings possessed by every normal person (b) A quantitative spectrum of individual differences in which they can be ranked and ordered (c) A qualitative, fine-grained account in which there is no comparisons between people. In the performance typology it is the aspect (b) of EI i.e. as quantitative spectrum of individual differences which is used for the purpose of emotional management in the organizational set up for achieving the desired performance.
- l) *Experience*: Experience is looking at the present through a rear-view

mirror and marching backwards into the future. In the performance typology, experience is learning by doing which converts explicit knowledge into tacit knowledge.

- m) *Feeling*: Feeling in essence, is an idea that resides within a person. It is thought to be a mapping of a particular body state by the mind in which a mental image (map) is formed. This 'mapping' of the body is composed of sensory feelings, called 'affects' that are directly evoked by specific inputs from the internal self and/or external environment. They include such evaluative experiences as hunger, thirst, pain, and sweetness. Feelings are not neutral, but rather hedonic in that they are either positive or negative, such as pleasantness or unpleasantness. Unlike emotions, such as pride or anger, they occur in the absence of any complex cognitive processes.
- n) *Intention*: Intention is a person's aspiration to her or his goals. It is a purposeful activity in specified direction. The forming of an intention seems to imply a free will and the ability to choose. A person normally has a strong will to self-actualize what he wants to become. Thus, intentions for him become the purposeful activities that his visions create. Intention has cognitive application.
- o) *Motivation*: Motivation is the combination of a person's desire and energy for achieving a goal. Motivation is the internal process that activates, guides and maintains behavior. It is the cause of action. Influencing people's motivation means getting them to want to do what is thought as must be done. Motivation can be 'intrinsic' like satisfaction, feelings of achievement; or 'extrinsic' like rewards, punishment, or achieving the goal. Carl Rogers has stressed that people have natural desire to learn and the teacher's role should be one of encouraging and supporting the learner to learn. According to Rogers, motivation for learning comes from within. Maslow developed a hierarchy of needs that range from biological to psychological. Though Rogers and Maslow considered that motivation is intrinsic, it may be seen that motivation is quite often goal centered and changes according to nearness of the goal. It is therefore important that tutor/trainer should ensure that both short and long term goals are given and achieved by suitable motivational inputs. There are many motivational theories like Achievement Theory, Activation Theory, Attribution Theory, Cognitive Evaluation Theory, Control Theory, Drive Theory, Equity Theory, ERG Theory, Expectancy



Theory, Hygiene Theory, Reinforcement Theory to name a few. Each theory lays emphasis on one or more aspect of psychological factors contributing to motivational behavior.

- p) *Result*: Result or impact of performance intervention are achieved by closing performance gaps, developing employees to achieve better results, improving process, and removing performance blocks. The objective of most performance interventions can be stated in terms of results or impacts, such as improved efficiency, reduced costs, or better quality. Performance improvement and impact operate symbiotically or in other words have reverse causality. Impacts also have been found to influence people's behavior and cause them to perform since people tend to continue behaviors that are perceived to be excellently effective. This two way flow is about state of consciousness where the performers are totally focused, energized, and confident.
- q) *Skill*: Skill can be defined as an expertise developed in the course of training and experience. Skill includes not only trade and craft skills acquired by apprenticeship, but high-grade performance in many fields, such as professional practice, the arts, games, and athletics. Skill requires that the performer has to match the demand of the task. This is accomplished by applying a 'strategy' of performance. This strategy can be seen in the improvisation done by the craftsman in the T&P used by him to meet the requirements of the task. These strategies are not normally concerned with a single response, but rather with chains or programs of action to obtain a result. Some strategies are more efficient than others. Skill consists of choosing and implementing the most efficient strategies. There are three main parts to a skill (a) Perception of object or events - perceiving all relevant factors to decide how best the job can be done. (b) Choice of response - making a decision for adopting certain way for the execution of job (c) Execution of the choice made - requiring motor coordination and timing. According to Peter Drucker 'skill can not be explained in words, it can only be demonstrated. Thus the only way to learn a skill is through apprenticeship and experience'. Apart from job execution skill, there is another kind of skill called 'social skill' which includes the perception of needs and desires of others, and of one's effect upon others. It is similar to EI and social pressure.

- s) *Skill gaps*: The required performance minus the present performance equals skill gap. A 'skill gap analysis' compares the performers skills with the skills required for the job in order to identify future performance improvement opportunities.
  - t) *Talent*: Talent is a special ability that amplifies skills and ability of a person in performing the given task.
  - u) *Values*: Values are the ideas about the worth or importance of things, concepts, and people. They come from a person's beliefs system. Values are one of the components of attitude. Values help to weigh the importance of various alternatives. They drive all organizational and individual efforts. In an organization, it is often the value system of the top management which is assimilated by the employees and made employee's value system.
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## CHAPTER 9

IDENTIFICATION OF LEARNING, TRAINING  
AND DEVELOPMENT NEEDS

## 1 Learning, Training and Development

**1.1** Identification of training and development needs: In present days emphasis is on leaner organization where tighter focus upon individual contribution has made the identification of training and development needs a critical element in determining the organization's success. Training is important but question is, what kind of training and to what level of details? The answer to these questions are sought by conducting Learning Needs Analysis (LNA) and Training Needs Analysis (TNA). There are three levels of training needs within an organization namely organizational, occupational and individual. Organizational level analysis addresses to training implications of new product, new technology, new process level, new legislation, new procedures and standards, new market/customer etc. At occupational level, training needs are determined by conducting job analysis for which many methods have been evolved by different professionals. At individual level, training analysis is directed towards bridging the gap between current level of performance and desired level of performance. The analysis phase conceptualizes the overall gamut of training program by analyzing the system to gain complete understanding of it. It provides understanding of tasks associated with each job to decide upon the tasks which are required to be trained. By building performance measures for the task performance, analysis phase helps determine as to who must be trained and in what manner. Instructional setting of the training is also decided in this phase. The product of this phase is the foundation for all subsequent development activities. One of the important activities of this phase is preparation of 'Task Inventories' which can be prepared by the training department or obtained from other departments within the organization. Study of literature should be the first step in any analysis to prevent redundant work from being performed.

**1.2** *Training Needs Analysis:* The analysis phase is often called a 'Front-End Analysis' because it is in this phase, that the task of training needs identification or problem identification is performed. For this purpose, following actions are taken: (a) Overview of system or process to gain understanding (if needed); (b) Analyzing the system; (c) Discovering Training Needs; (d) Compiling Task Inventory (if needed); (e) Analyzing the task; (f) Needs analysis; (g) Templating; (h) Document analysis; (i) Building Performance measures; (j) Selecting instructional setting and (k) Estimating training cost. These steps are discussed briefly in this chapter.



**1.3 Overview of the System or Process to Gain Understanding:** Where training department is an integral part of the organization or where the training department is conversant with the organization structure, processes and culture of the organizations, then some of the steps as thought fit by the training managers may be skipped. It is the familiarity with the clients which will determine the scope of system overview that will need to be performed. In case the organization is facing a performance problem, then it is preferred to review pertinent part of the system to properly understand the job and task requirements being performed in that system. Estimation of training cost may be required for demanding training budget and for charging training cost when training is rendered to other organization or department on cost.

## **2 Analyzing the System**

**2.1 Needs of Client:** Many a times training programs fail to achieve their objective because the needs of the client are not properly understood. The purpose of this activity is to aid in the decision making process by defining all the elements, issues, facts and features taking place in the client's system or process. The information gathered in this step provides a basic background for training managers, developers, consultants etc. This step allows the training activity to understand the technical, non-technical, political, social, and cultural aspects of the client's system. Primarily, it is an information gathering technique to provide a solid background for anyone involved in the training process. This phase also allows the client to understand the training activity and its purpose. Analysis phase helps client understand their organizational process from the perspective of training managers. Besides introducing training activity the clients will be able to perceive system differently compared to what they themselves helped to define.

**2.2 Process Analysis:** A process is a planned series of actions that advances a material or procedure from one stage of completion to the next. They are identifiable flow of interrelated events moving over time towards the goals of organizational improvement and individual development. A process starts with a trigger that causes a specific action to be taken by a person, another process, or work group. The ending of process occurs when the results get passed on to another person, process, or work group. In the analysis phase, performance of task needs to be fully understood as to 'what kind of task is processed in which manner' to build performance measures which are sought to be attained through training. Knowing the basics of a system enables the professionals in the training department to better understand the tasks that lay ahead. Although in the analysis phase, systems and processes specific to training are looked in to for understanding their purpose and goals, the main emphasis of this initial

research should be on the people within the system. As much as possible information about potential learners should be gathered. The target population data is essential and most useful when making decisions about the proposed learning program. People in the organization being the one who process the task, they constitute the biggest variable in a training program.

**2.3** Listed below are some of the aspects which need to be looked into in the initial work:

- i) Anticipated number of learners;
- ii) Location of learners;
- iii) Education and experience of the learners;
- iv) Background of learners;
- v) Experience in present or related jobs;
- vi) Job performance requirements versus present skill levels;
- vii) Language or cultural differences of learners ;
- viii) Motivation of learners;
- ix) Physical or mental characteristics of learners and
- x) Specific interests or biases of learners.

The information gathered should be sufficient to provide 'big picture' of the system and the people who work in it, to one who may not be familiar with the system.

### **3 Discovering Training Needs**

**3.1** There are two main methods to discover training needs. The first method takes the proactive approach. This is when a training analyst goes into the system or process and searches for problems or potential problems. The goal is to make the system more efficient and to prevent future problems from occurring. When a new employee is recruited his SKAs are known, and the SKAs which will be expected from him for efficient job performance is also known. The second method is when the organization, department or a wing of the organization asks the training department for help in fixing a problem. These problems are usually caused by new hires, promotions, transfers, appraisals, rapid expansion, changes, or the introduction of new technologies. In such cases, first, the problem is investigated. Investigation may

indicate that a training need exists when an employee lacks the knowledge or skill to perform an assigned task satisfactorily. In other words, training need exists when there is a variation between what the employee is expected to do on the job and what the actual job performance is. To decide if training is the answer, one basic question needs to be asked, 'Does the employee know how to meet the required performance standards for an accountable task?' If the answer is "No," then training is needed. If the answer is "Yes" then another action, besides training, is needed. The answer 'Yes' should be, however validated by further related queries. Where it is felt that training is not required, then some other actions like counseling, job re-design, or organizational development can be initiated. Often, the employee does not perform to standards due to time factors, working conditions, or a misunderstanding of the required standards. Management must recognize and consider other factors which impact performance that may not be corrected with training. Factors such as quality of procedures, human factors, management style, and the work environment also affect performance. These factors may be required to be suitably addressed using behavioral science theories.

### **3.2** Some questions that might be asked to determine training needs are:

- i) What are the employees doing that they shouldn't be doing?
- ii) What specific things would be expected from the employees that they should do, but they don't do?
- iii) When we envision employees performing their job properly, what do we envision them doing?
- iv) What prevents the employee from performing a prescribed task to standards?
- v) Are job aids available and if so, are they accurate? Are they being used?
- vi) Are the standards reasonable? If not, why?
- vii) If the employee could change one thing in the task he performs then, what would it be?
- viii) What subject would we like to see the employee/ workers trained on?
- ix) What new technology would benefit the employee/worker the most, in the performance of his job?
- x) What new technology would we wish to see invented to help the employees with their work and why?



The data gathered must accurately reflect the specific tasks now being performed. The information gathered will be used as the basis to select the tasks that need to be trained.

## 4 **Compilation of Task Inventory**

**4.1** Compilation of Task Inventory includes compilation of a Job list, Job descriptions, and task inventory for each job which may not be normally performed every time one researches a performance problem. But they are essential to anyone involved in HRD, management, or performance as they set the standards for how a job is to be performed. If the job and task inventories have already been compiled, then it should be reviewed and updated before moving on to the task analysis or needs analysis.

**4.2 *Job List:*** A job list is a compilation of all job titles associated with the system. Jobs are collection of tasks and responsibilities. A job is generally associated with the employee's title. Wireman, supervisor, surveyor, design engineer, quantity survey are jobs. A job consists of responsibilities, duties, and tasks that are defined in organization manual and can be accomplished, measured, and rated. It is used as an employment tool for classifying work and for selecting employees.

**4.3 *Job Description:*** After listing the jobs, a job description is then obtained by performing a job analysis. Job analysis is the process of breaking down the complexity of a person's job into logical parts. It identifies the knowledge, skills, and attitudes (KSA) required for performing the job correctly. It is often concerned with the subjective elements of a job that is, expectations and attitudes. An indicative list of jobs description in highway sector organizations at various policy planning, project planning, work execution and maintenance levels are given in **Annex-2**. There are five components of a job. (i) Job - the main description of what a person does. (ii) Duties – it contains two or more tasks (iii) Tasks- it contains two or more elements and has identifiable beginning and end. (iv) Elements- it contains two or more SKAs (v) SKAs. To illustrate, a 'mechanic' is a job; his duty is to tune engine; his task is to clean the carburetor (a task has a verb and object); his element is to replace the defective parts on the carburetor and finally his SKA is that he must know about different parts of engine, carburetor and their assembly system.

**4.4 *Task Inventory:*** Job of an employee is the identification of SKA attributes required to perform job correctly whereas a task is a function the employee performs, such as surveying, making entries in measurement book, preparation of payment bills, or posting accounts into a ledger. A task is a well defined unit of work. It stands by

itself. It is a logical and necessary action in the performance of a job or duty. It has an identifiable start and end point and results in a measurable accomplishment or product. Task involves application of Skills, Knowledge, and Attitudes (SKA) to perform a task. Some jobs may only have a couple of tasks associated with them, while others will have dozens of tasks.

**4.5** The following are characteristics of tasks:

- i) A task has a definite beginning and end;
- ii) Tasks are performed in measurable period of time;
- iii) Tasks are observable. By observing the performance of a jobholder, a definite determination can be made that the task has been performed and
- iv) Each task is independent of other actions. Tasks are not dependent on components of a procedure. A task is performed by an individual for its own sake.

**4.6** **Task Statement:** A 'task statement' is a statement of a highly specific action. It always has a verb and an object like 'doing quantity surveying' or 'making architectural drawing' or 'compacting the earth' etc. A task statement should not be confused with an 'objective' which has conditions and standards and may be a culmination of many tasks performed by different systems like 'construction of a bridge in eighteen months' or 'constructing an office building which is efficient, effective and to the satisfaction of clients' which are objectives. The task inventory consists of all the tasks that a jobholder or an employee is required to perform to some specified standards. Each and every task performed by the job incumbent must be listed on the task inventory. It provides vital information about the skills, knowledge, and abilities required to perform a job. This information is valuable for developing employee selection procedures and training programs. For training purposes, it tells the developer what the job requires. It is also valuable for setting standards in performance appraisals and evaluating jobs to determine the rewards, compensation etc. Tasks inventory should be prepared indicating how a task is performed, and stating the objective. For example in the task inventory of 'compiling progress reports using MS Excel' task objective is compiling the progress report which is performed by using MS Excel. One way of getting a comprehensive list is to have the employees prepare their own list, starting with the most important tasks and then, comparing these lists with the list prepared by the training manager. Task analysis should specially be performed very meticulously whenever there are new processes or equipment, when job performance is below standards, or when requests for changes to current training or for new training are received.

**4.7 Selecting the Tasks:** After having understood the system or process being researched, the purpose of the system, the people within the system, the main goals they are trying to achieve, the jobs and the associated tasks the system requires; next step is to select the tasks to be trained. Often it helps to select tasks for training by dividing them into three groups namely (i) Those that are to be included in a formal learning program; (ii) Those that are to be included in On-the-Job-Training (OJT) and (iii) Those for which no formal or OJT is needed (i.e., job performance aids or self study packets). Following factors should be considered when selecting tasks to be trained:

- i) What will happen if this task is not trained?
- ii) What will be the benefits if this task is trained?
- iii) How will this training help to achieve training intents/ goals?
- iv) Will training enhance measurable and visible performance improvement?
- v) If not trained, how will the employee learn the task or improve the task performance?
- vi) Can trained people be hired cost effectively for the task performance instead of training the employee?
- vii) Is the training mandated by some legislative requirement like Occupational Safety?
- viii) Can self study packet be used in place of formal training?

## **5 Analyzing the Tasks (Task Analysis)**

**5.1** A task analysis defines a job in terms of SKA which are necessary to perform daily tasks. Task analysis is a structured framework that dissects a job and arrives at a reliable method of describing it across time and people by composing a detailed listing of all the tasks. The first product of a task analysis is a task statement for each task which is composed of an action and a result (product). For example in the task 'the site engineer checks and approves the 250 mm GSB layer' the 'checking' of GSB layer is an action which is governed and guided by the specifications and 'approve' is the product of action 'checking'. Or, in the task 'spreading of GSB is carried out by the motor grader to achieve proper line and gradients' the action is 'spreading of GSB by motor grader' which results into a product 'as per lines and levels'. It will be noticed that the action can be mental such as 'approving' or physical such as 'spreading'. Some



other examples of mental action would be 'analyze, calculate, predict, and design'. Physical examples of action may include, 'spread, lay, roll, compact, dig, move' etc. Actions can also deal with people such as counsel, mentor, teach, and explain. For example in 'Surveyor explaining working of new Theodolite to site supervisor', action is 'explaining' which results into a product of 'site supervisor who is comfortable with the operation of new Theodolite'. Task actions are usually sorted into People, Data and Thing, to identify the main characteristics of the job. Good task statements are not easy to write as they require in depth analysis of the job. Once the task statement has been defined, the task analysis will then go into further detail by describing the task frequency, difficulty of learning, importance of training the task, task difficulty, task criticality and overall importance of task. These details will enable the trainer to identify the SKA required for successful task performance. Methods generally employed for performing a task analysis are observations, interviews, and questionnaires. When deciding which tasks to train, two guiding factors are that it should be effective and efficient. In other words, training program to be selected should meet the learning intents within acceptable costs.

**5.2** Following questions may be asked when performing a task analysis:

- i) How difficult or complex is the task?
- ii) What behaviors are used in the performance of the job?
- iii) How frequently is the task performed?
- iv) How critical is the task to the performance of the job?
- v) To what degree is the task performed individually, or is part of a set of collective tasks?
- vi) If the task is a subset of a set of collective tasks, what is the relationship between the various tasks?
- vii) What is the consequence if the task is performed incorrectly or is not performed at all?
- viii) To what extent can the task be trained on the job?
- ix) What level of task proficiency is expected following training?
- x) How critical is the task?
- xi) What information is needed to perform the task? What is the source of information?

- xii) What are the performance requirements?
- xiii) Does execution of the task require coordination between other personnel or with other tasks?
- xiv) Are the demands (perceptual, cognitive, psychomotor or physical) imposed by the task excessive?
- xv) How often is the task performed during a specified time-frame (i.e., daily, weekly, monthly, yearly)?
- xvi) How much time is needed to perform the task?
- xvii) What prerequisite skills, knowledge, and abilities are required to perform the task?
- xviii) What are the current criteria for acceptable performance? What are the desired criteria?
- xix) What behaviors distinguish good performers from poor performers?
- xx) What behaviors are critical to the performance of the task?

Format may be developed for obtaining and compilation of answers to above questions. Such format can be under the caption 'Task Performance Measure' or 'Build Performance Measures' depending upon the queries.

**5.3 Cognitive Task Analysis:** For tasks with a high cognitive component, (i.e., decision making, problem solving, or judgments), a traditional task analysis may fail to identify those cognitive skills required which one may require to perform a given task or job. A cognitive task analysis is performed to identify and to describe the cognitive components of a task. There are a variety of methodologies available to help the training designer to represent and define the various knowledge structures needed to perform a task or job. There are three knowledge (cognitive) structures namely, declarative, procedural and strategic.

- a) *First knowledge structure:* Declarative knowledge tells us why things work the way they do like 'water flows from higher to lower level' or that the object or thing has a particular name or location like 'Delhi is capital of India'. It includes information about the concepts and elements in the domain and the relationships between them. Declarative knowledge includes facts, principles, rules of science and concepts like "Knowing the rules of good database design" or 'knowing the steps for working

out rates analysis of an item' or 'knowing the procedure for fixing plinth level' etc. Methods for eliciting declarative knowledge can be through 'Card Sorting process' in which the researcher obtains sets of concepts that broadly cover the domain (derived from glossary, texts, or gleaned from introductory tutorial talk), then transfers each concept onto a card. Subject Matter Expert then sort the cards into common groups or functions according to similarity or some other sorting criteria. These groups are then further grouped until eventually a hierarchy of groups is formed. Another method uses 'Data Flow Modeling' in which an expert is interviewed. The researcher then draws data flow diagram using data gathered from interview.

- b) *Second knowledge structure:* Procedural knowledge which tells how to perform a given task. Procedural knowledge contains the discrete steps or actions and the available alternatives to perform a given task. With practice, procedural knowledge can become an automatic process, thus allowing one to perform a task without conscious awareness. This automatically also allows one to perform more than one complex task at a given time. A couple of examples would be 'check the BM base course for line, grade and camber using template' or 'compacting the side slopes using plate vibrator'. Methods for eliciting procedural knowledge uses techniques like 'Interviewing' which is a variation of a basic interview and includes (i) working backwards through the problem (ii) drawing a concept map (iii) showing an expert photographs depicting system in a number of states and asking questions and (iv) expert describes procedure to interviewer and then the interviewer teaches it back to the expert.
- c) *Third knowledge structure:* Third structure of knowledge is 'strategic knowledge' which comprises of information forming the basis of problem solving, such as action plans to meet specific goals; knowledge of the context in which procedures should be implemented; actions to be taken if a proposed solution fails; and how to respond if necessary information is absent. An example of this would be a Superintending Engineer or Chief Engineer, who formulates plan for the construction of building as per client's requirement covering architectural design, structural design, landscape design, execution of work etc. Methods for eliciting strategic knowledge are (i) Critical Decision Method – In this, interview of expert is taken to identify non-routine events that challenged his expertise and events which made a significant difference to his decision making. A time



line of events is then constructed and key points are further probed; (ii) Non-Critical Decision Method – In this, a semi-structured interview is performed utilizing specific probes designed to elicit a particular type of information. The data is then examined for perceptual cues, judgment details, and decision strategy details that are not generally captured with traditional reporting methods.

**5.4 Functional Analysis:** When a position that performs a large number of tasks (e.g. manager or engineer) is analyzed, a technique called functional analysis can be used. Rather than conducting a job analysis to identify specific tasks, major functions within the position are identified. After the competencies necessary to perform the major functions are identified, those competencies can be analyzed to determine objectives for training. For example, a site engineer might make many plans such as work execution plan, plan for making site available, plan for traffic diversion, plan for arranging workers for doing the planned job, planning material for work execution etc. The training objectives needed to perform these actions might read as: SKAs to Create bar chart, activity network chart, resource planning using MS Project.

## **6 Needs Analysis**

**6.1** A Needs Analysis is done for complete understanding of the shortcomings of the system. While a task analysis looks strictly at the tasks performed on the job, a needs analysis looks not only at the tasks being performed, but also at other parts of the system that might yield clues at what might be done to improve it. Depending upon the training intents, training analyst may perform one, both, or a hybrid of the two. Generally, the analyst generates a list of tasks to be performed. This list is integrated into a survey which covers job incumbents, subject matter experts and supervisory personnel where the respondents are asked to evaluate the frequency, the criticality of each task for the successful performance of the job, and the amount of training which they feel they require reaching proficiency level. The surveys are then compiled and findings are discussed and tasks approved. For many jobs, this basic traditional task analysis works just fine. For others, some different tools might be required. The following are the instruments that may be incorporated into the needs analysis.

**6.2 People-Data-Things Analysis:** Jobs are often characterized by the proportions of time spent on people, data, and things. Performance deficiencies are often the result from a mismatch between the nature of a job, and the employee's preference for focus on people, data, or things. Although most jobs entail that the jobholder work with all three, there is usually one of the three that the job most extensively focuses on. Listing all job responsibilities under one of the three categories

will provide the information as to what major role an employee will be expected to fulfill -- a people person, a data person, or a thing person.

**6.3** The following verbs help to properly place a responsibility into a category:

- i) People duties - advises, administer, briefs, communicates, coordinates, conducts, consults, counsels, critiques, delegates, demonstrates, directs, explains, facilitates, guide discussions, implements, informs, instructs, interviews, manages, mentors, negotiates, notifies, plans, participates, persuades, promotes, provide feedback, organizes, sells, speaks (public), sponsors, supervises, teaches, trains, tutors, welcomes
- ii) Data duties - analyzes, arranges, audits, balances, budgets, calculates, compares, compiles, computes, designs, determines, documents, estimates, forecasts, formulates, identifies, lists, monitors, obtains, predicts, prepares, selects, surveys, tracks
- iii) Thing duties - activates, adjusts, aligns, assembles, calibrates, constructs, controls, cooks, cuts, develops, disassembles, drives, grows, inspects, lifts, loads, maintains, maneuvers, monitors, mixes, operates, paints, packs, repairs, services, transports, writes

**6.4** **Tabletop Analysis:** Using a facilitator, a small group of 3 to 10 Subject Matter Experts (SME) convene to identify the various tasks to be performed. A minimum of one job holder and one supervisor are needed to discuss the tasks. The facilitator conducts the sessions and documents the information. Through brainstorming and consensus building, the team develops a sequential list of tasks. Following this process, the team determines which tasks should be trained. Task selection is based on the frequency, difficulty, criticality and the consequences of error or poor performance. This method is labor intensive for the subject matter experts. The validity of the identified tasks is dependent upon the credibility of the selected subject matter experts. For consistency, the team of experts should remain the same throughout the process. The table-top method of job analysis typically consists of (i) Orienting the team (ii) Reviewing the job. (iii) Identifying the duty areas associated with the job (iv) Identifying the tasks performed in each duty area and write task statements (v) Sequencing the duty areas and task statements and (vi) Selecting tasks for training.

**6.5** **Hybrid Method:** This involves both a quantitative analysis and consensus building. Using job task documents, a list of tasks is compiled by an analyst. Through an iterative process involving consensus building, the validity of the task list is assessed

by subject matter experts, supervisors and job holder. Through discussions, each task's complexity, importance and frequency are numerically rated by members of the consensus group. Once the tasks are identified, the group identifies and validates the knowledge, skills and abilities required to perform each task.

## 7 Templating

**7.1 *Document Analysis and Building Performance Measurements:*** Training content can be determined by the careful review and analysis of a template (a list of system facilities, procedures, theory topics, or generic learning objectives). The template technique uses a simplified process for determining content or developing learning objectives associated with the operation or maintenance of a specific system. This technique produces generic and system-specific learning objectives for the training and evaluation of personnel. A template containing generic learning objectives is reviewed by subject matter experts for applicability. This approach directly generates system-specific terminal and enabling learning objectives. It is important that the template be carefully reviewed to determine the applicability of each item to the system. The template technique includes (i) Develop or modify an existing template to meet facility needs.(ii)Use of a trainer and a subject matter experts to select applicable objectives and/or complete portions of the template for a given system, component, or process.

**7.2 *Document Analysis:*** This technique is especially valuable when accurate procedures and other job related documents are available. Document analysis is a simplified technique for determining required knowledge and skills directly from operating procedures, administrative procedures, and other job related documents. A SME and a trainer review each section and step of the procedure or document to determine training program content. Document analysis consists of (i) Review the procedure or document and list the knowledge and skills required by a jobholder and (ii) Verify the accuracy of the results.

**7.3 *Building Performance Measures:*** Constructing performance measures for each task to be trained is one of the critical steps for achieving the performance measures. This information provides documentation for the correct performance of tasks. Performance measures are the standards for how well a task must be performed. The task performance measures so developed by the training professionals should be discussed and approved by the client management. Document for recording the performance measure should describe the conditions, behavior (task), performance measures, and critical task steps for the task. This document will later be used to build the learning objectives. It is also valuable for documenting how to perform a task and how well it must be performed in that it aids management in their evaluations of the job



holder. There are four basic analysis techniques used to ensure that all performance measures associated with a task are recorded:

- i) *Observation task analysis*: In this technique, task under actual working conditions is observed and each step for performing the task and the standards of performance is recorded;
- ii) *Simulated task analysis*: In this technique, working conditions are simulated and skilled individuals or groups performing the task are observed. The working conditions should match the job environment as closely as possible. Each step and standards of performance with inputs from the skilled performers are recorded;
- iii) *Content analysis*: In this technique, operating or technical manual are analyzed to determine the steps and standards of performance and
- iv) *Interview analysis*: In this technique, SMEs are consulted to determine the required steps and standards of performance. This technique can be used to validate the data gathered by other techniques. This method should generally not be used alone as SMEs often leave out vital steps of the tasks as some of the steps become so internalized that experts fail to acknowledge doing so.

## **8 Selecting Instructional Setting**

**8.1** This step selects the appropriate delivery system or medium of instructions and decision about how the training will take place. The instructional setting is the major medium of a training program, for example, it may be decided that a Job Performance Aid (JPA) will be most suited delivery system for operating a piece of equipment or classroom training for learning teamwork, or Computer Based Training (CBT) for imparting a new skill.

**8.2** The instructional setting has 'minor media' within it. Minor media are the learning strategies that instruct the learning points or steps. For example a JPA instructional setting might have two - a sign/marker for starting the equipment and a manual for performing the various operations. The classroom setting could have charts /graphs for teaching some technical concept, multi media for teaching communication skills , and lectures for introducing new information. The CBT could use video, self-tests, and simulations. Next step in the selection of instructional setting is deciding about the required delivery system.

**8.3** Following can be the options to consider when selecting the delivery system:

- i) *Feedback*: Sometimes the job of the trainer is not to train the workers who cannot perform the task, but to train their supervisors or managers in effective coaching and supervision methods. By receiving feed back from the supervisor, trainer decides about the delivery system which can most effectively bridge the performance gap.
- ii) *Classroom*: This is normally viewed as the traditional type of training. It is best used in lectures or team training setting. Its main disadvantage is that no one learns at the same pace.
- iii) *Self-paced*: This allows the learners to proceed at their own pace and is suitable for learners pursuing cognitive skills like computation, analysis etc but it require more development time and coordination.
- iv) *JPA/OJT*: This includes Job Performance Aids (JPA) such as manuals and On-the-Job training (OJT). JPA are normally the cheapest method to implement while OJT can provide high quality, cost effective training. The disadvantage is the interruptions that take place in the workplace with OJT, while JPA provide no supervision or coaching.
- v) *Specialized*: Best-Of-Class Model (blended, hybrid or modular) are a combination of various media that provides the learners with the best type of instruction - this should be the goal of any training program. Also included in this category are Coaching and Mentoring.

**8.4** Although most learning objectives and concepts can be taught using almost any of the many types of training media, most have an ideal medium in a given learning situation. When selecting training media, one needs to consider learner needs, resources, experience, and training goals. The goal of a good training effort is to build a viable and efficient program. That is, it should provide the best learning environment at the lowest possible cost. Selecting the best medium for each module and incorporating it into the delivery system helps in making training course a Best-Of-Class program. Basic Guidelines, however are to enable the learners to master the new or existing technology in a professional, effective, and efficient manner. An illustrative needs analysis template is given at **Annex-3**.

## **9 Training Cost**

The last step in the analysis phase is to document the training project and perform an estimate of the cost to implement it. It has been added in this phase as organizations

must be able to plan and budget their resources well in advance. In case the budget procurement sometimes takes time, training program can proceed on to next phase of designing the program after obtaining an approval from the management for arranging the budget on submission of rough cost estimate. Thus as per the requirements it is possible to plan the training and development program and simultaneously assess costs, if required.

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**CHAPTER 10****PLANNING AND DESIGNING OF TRAINING AND DEVELOPMENT****1 Determining Training Method**

**1.1** After having analyzed the organization, processes, occupation, individual job and tasks and deciding that there exists training need, next step is to determine the training methods that could be used in the delivery of training courses. Design or methods, is understood to be a known approach or procedure; an acknowledged practice by the trainers as a way of teaching or promoting learning. The concept of design represents the basic 'how to' level of training as a sub component of learning objectives. It also embraces use of 'technique' and 'material'. For example, 'lecture' can be a training method but the technique of lecture will take into account the characteristics of learners like whether they are logical- mathematical or visual-spatial. Trainer will accordingly decide upon 'attitude scales' of his lecture and use material like charts or hand-outs as may be appropriate for the purpose of instruction's delivery. Design or delivery method is thus a tool which the trainer uses for optimal use. Therefore, it is essential that a trainer must have teaching skills, concern and competence. The choice and appropriate use of training design will clearly be influenced by the knowledge and skill of trainer. There are number of training methods like learning cycle, planned and emergent learning, neuro-linguistic programming, multiple intelligence, experiential learning etc. Understanding of these theoretical concepts helps the trainer in the selection, design and use of training methods. This phase thus ensures the systematic development of the training program. This process is driven by the products of the analysis phase and ends in a model or blueprint of the training program for future development.

**1.2** To focus the training program on the required task performance measurements, following development order of training programme should be followed after analyzing the task to determine the objective as described in previous chapter.

- i) Developing the learning objective fully and determining if it has any enabling objectives. If it does, then such enabling objectives must be clearly spelt out;
- ii) Identifying Learning Steps required for performing the objective to standards;
- iii) Building a test instrument to determine if the learner can perform the steps that are required to reach the objective and includes steps like planning the test, and developing the tests (kind of tests, type of tests);

- iv) Listing Entry Behavior for checking the entry behavior of target population and
- v) Program Sequencing, Structuring or developing course content that will train the learners to perform the objective. Learners can perform the objective if they can meet the evaluation standards. The 'objective' is the focal point of this development order. The objective specifies what behavior must be displayed by the learner to perform the task to standards. Training is then developed to teach the steps that will best lead to the desired behavior.

## **2 Developing Learning Objectives**

**2.1** In the analysis phase, one discovers what needs to be trained. In this phase, writing clear learning objectives answers the question, 'What will the learners be able to do when they finish the training program?' Only with well constructed learning objectives, instructors will know what is to be taught, learners will know what they are supposed to learn, and organizations will know the final utility of training budget investment. Learning objectives form the basis for 'what is' to be learned, 'how well' it is to be performed, and under 'what conditions' it is to be performed. A learning objective is a statement of what the learners will be expected to do once they have completed a specified course of instruction. It prescribes the conditions, behavior (action), and standard of task performance for the training setting. For example, a learner's knowledge is a state of mind which cannot be directly measured but an indirect evaluation of the same can be done by observing his behavior or performance. Objectives are different from goals. Goals describe a learning outcome in general terms. For example, 'the learner will successfully complete the surveying course, before moving on to the survey supervisor's course.' It gives general indication of direction to be followed but provides no guidance about how to achieve it. On the other hand, an objective is a specific statement of instructional intent which attempts to change knowledge, skills or attitudes as a result of a learning experience. For example, 'the learner will master Theodolite survey before moving on to computerized Total Station Survey'. Specific 'Terminal Learning Objectives' must be developed for each of the tasks selected in the learning program. A Terminal Learning Objective is the highest level of learning (SKA) appropriate to the human performance requirements a learner or trainee is expected to accomplish. Each terminal learning objective is analyzed to determine if it needs one or more enabling learning objectives, that is, whether it needs to be broken down into smaller, more manageable objectives. An enabling learning objective thus measures one of the elements of the terminal learning objective.

## 2.2 A learning objective has three main components as follows:

- i) *Task or observable action*: This describes the observable performance or behavior. Observable action is a statement which defines some 'doable' activity using a verb in the statement. For example 'weld a joint' or 'lift a load'. Each objective covers one behavior; hence, only one verb should be present. If there are many behaviors covered or the behaviors are complicated, then the objective should be further broken down into one or more enabling learning objectives that support the main terminal learning objective.
- ii) *Standard or atleast one measurable criterion*: This states the level of acceptable performance of the task in terms of quantity, quality, time limitations, etc. This must answer any question such as 'How much or how many?' 'How fast?' or 'How well?' For example 'At least 30 Cubic meter of concrete must be produced within one hour'. Or 'meeting quality standards of M35 concrete'. There can be more than one measurable criterion.
- iii) *Conditions or environment*: It describes the actual conditions under which the task will occur or be observed. Also, it identifies the tools, procedures, materials, aids, or facilities to be used in performing the task. This is generally expressed with a prepositional phrase such as 'using batch mix plant' or 'by checking temperature of the hot mix'.

## 2.3 Illustration below are given as examples of learning objectives

**Example 1: Prepare a road work estimate with no calculation mistakes using MORTH specifications.**

**Observable Action:** Prepare a road work estimate.

**Measurable Criteria:** with no calculation mistakes

**Conditions of Performance:** using MOR&TH specifications.

**NOTE:** Generally speaking, the larger the organization or the more technical the task, the more specific the conditions of performance must be spelled out. In the above example, the task of road estimate preparation can be further broken down in to enabling objective like 'work out quantity of material from the drawing using CAD software' and 'work out rates of material using MOR&TH analysis of rates' etc.



**Example 2: Interpret contour map obtained from GPS elevations database within 5 minutes without using comprehensive chart analysis.**

**Observable Action:** Interpret contour maps obtained from GPS elevations database.

**Measurable Criteria:** within 5 minutes

**Conditions of Performance:** without using comprehensive chart analysis.

**Example 3: Complete the design of sinking well by tomorrow, even when exhausted, unless you fall sick.**

**Observable Action:** Designing sinking well.

**Measurable Criteria:** 24 hours.

**Conditions:** even when exhausted

**Variable:** unless you fall sick.

**Example 4: After training, a Beldar will be able to load a dumper truck with 3 loads of a scoop loader, in the hours of darkness, unless the work area is muddy.**

**Observable Action:** load a dumper truck

**Measurable Criteria:** with 3 loads

**Conditions:** a scoop loader in the hours of darkness

**Variable:** unless the work area is muddy

**2.4** The learning objective spells out the exact training requirement. As seen above, if estimate is prepared in 10 days even after the training which aimed at enabling the learner to do the job of estimate preparation within one day or a beldar fails to load the dumper truck with three scoops after the training, then the learning objectives are not met and time and money spent on training is not properly utilized. A clearly formulated objective has two dimensions, a behavioral aspect and a content aspect. The behavioral aspect is the action the learner must perform, while the content is the product or service that is produced by the learner's actions. For example in the statement 'the laboratory technician will learn determination of OMC of soil sample by studying Road Works Manual' there is no outcome of training but an activity of

learning. Reading a manual is an activity of learning (behavioral aspect) but there is no service produced by the learner's action (content aspect). In another example 'Given a forklift, load a stone boulder into a trailer without any safety errors'. In this example, the behavioral aspect is loading a trailer, while the content aspect is a stone boulder placed on the trailer. Learning objectives look very similar to tasks. A task analysis itemizes each discrete skill found in a job, but it provides only end goal statements, while learning objectives spell out the pre-requisite skills and makes them the course objectives. The learning objective should be a good simulation of the conditions, behaviors and standards of the performance needed in the real world. Hence, the evaluation at the end of the instruction should match the objective. The methodology and contents of the learning program should directly support the learning objectives. The instructional media should explain, demonstrate, and provide practice. Then, when students learn, they can perform on the test, meet the objective, and perform as they must in the real world.

### **3 Identifying Learning Steps**

**3.1** After formulating the learning objectives, next step in the design phase is identification and compilation of learning steps. The learning steps are compiled into a list that specifies each activity that must be performed in order to successfully complete the task. For example, the learning steps for the objective 'Given a sloping embankment, check for benching requirement for widening existing embankment' might read like this:

- i) Check slope of the existing embankment to find whether it is steeper than 4:1;
- ii) Create 0.3 meter wide horizontal bench by cutting into old slope;
- iii) Check for using material obtained from cutting of benches for widening purpose;
- iv) Add fresh embankment material;
- v) Check for bond between fresh embankment materials with old slope;
- vi) Check for the new slope after adding new embankment material and
- vii) Check for compaction requirement of widened portion.

**3.2** Various enabling objectives required to perform above mentioned steps like, how to check slope (step 1), how to create bench of required width (step 2), checking properties of excavated material before mixing the same with fresh material

(step 3) etc. should also be fully spelt out and learning steps for each of such enabling objectives should be prepared.

## 4 Building Test Instruments

**4.1 Building Test:** Instruments means suitable that tests are required to be developed to evaluate the learner's in depth knowledge of the learning objective. It exposes the learner about the pre-requisite skills he will need to develop prior to undertaking task performance. In depth knowledge about learning objectives and learning steps creates an automatic and in built standard and prescribed approach towards task performance. It also helps to provide feedback to both the learner and the instructor. Tests are often referred to as 'evaluations' or 'measurements'. Various terms used for evaluation of learner are defined as below:

- i) *Test or test instrument:* It is a systematic procedure for measuring a sample of an individual's behavior, such as multiple-choice, performance test, etc.
- ii) *Evaluation:* Evaluation is the process of determining the value and effectiveness of a learning program, module, and course. It is a systematic process for the collection and use of information from many sources to be applied in interpreting the results and in making value judgments and decisions. This collection of results or scores is normally used in the final analysis of whether a learner passes or fails. In a short course the evaluation could consist of one test, while in a larger course the evaluation could consist of dozens of tests.
- iii) *Measurement:* It is the process employed to obtain a quantified representation of the degree to which a learner reflects a trait or behavior. This is one of the many scores that an individual may achieve on a test. An evaluator is most interested in the gap between a learner's score and the maximum score possible. If the testing instrument is true, then measurement indicates the area that the learner did not master.

**4.2 Planning the Test:** Test items should be recorded in planned manner. Without an advance plan, some test items may be over represented while others may stay untouched. Often, it is easier to build test items on some topics than on others. These easier topics tend to get over-represented. It is also easier to build test items that require the recall of simple facts, rather than items calling for critical evaluation, integration of different facts, or application of principles to new situations. A good test or evaluation plan can have a descriptive scheme that states what the learners may



or may not do while taking the test. It includes behavioral objectives, content topics, the distribution of test items, and what the learner's test performance really means.

**4.3 Kinds of Tests:** The most commonly used varieties of tests in training programs are Criterion Referenced Written Tests, Performance Tests, and Attitude Surveys. Although there are exceptions, normally one of the three types of test is given to test one of the three learning domains. Although most tasks require the use of more than one learning domain, there is generally one that stands out. The dominant domain should be the focal point of the test evaluations. Different kinds of tests are briefly described below:

- i) *Criterion referenced test:* It evaluates the cognitive domain which includes the recall or recognition of specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills. The testing of these abilities and skills are often measured with a written test or a performance test. A criterion referenced evaluation focuses on how well a learner is performing in terms of a known standard or criterion. This differs from a norm referenced evaluation which focuses on how well a learner performs in comparison with other learners or peers.
- ii) *Performance test:* It evaluates the psychomotor domain which involves physical movement, coordination, and use of the motor-skill areas. Measured in terms of speed, precision, distance, procedures, or techniques in execution. It can also be used to evaluate the cognitive domain. A performance test is also a criterion referenced test if it measures against a set standard or criterion. A performance test that evaluates to see who can perform a task the quickest would be a normal referenced performance test.
- iii) *Attitude survey:* It evaluates the affective domain which addresses the manner in which emotive elements are dealt with and include things such as feelings, values, appreciation, enthusiasms, motivations, and attitudes. Attitudes are not observable therefore a representative behavior is required to be measured. For example, it is difficult to tell whether an employee is well motivated by looking at him, but his representative behavior such as being on time, working well with others, performing tasks in an excellent manner can give fairly good assessment with regard to his motivation level. Since attitudes are defined as latent constructs and are not observable in themselves, the

developer must identify some sort of behavior that would seem to be representative of the display of the attitude in question. This behavior can then be measured as an index of the attitude construct. Often, the survey must be administered several times as employees' attitude will vary from day to day, indeed, sometimes even hour to hour. Before and after measurements should be taken to show the changes in attitude. Generally, a survey is conducted one or more times to assess the attitude in a given area, then a program is undertaken to change the employee's attitudes. After the program is completed, the survey is again administered to test its effectiveness.

## 5.1 Types of Tests

5.1 Having a learner perform the task under realistic conditions is normally a better indicator of a person's ability to perform the task. The performance test or a criterion referenced written test should be used to measure the learners' achievements against the objectives. The test items should determine the learner's acquisition of the KSAs required for performing the task. Since a written measuring device samples only a portion of the population of behaviors, the sample must be representative of the behaviors associated with the task. Since it must be representative, it must also be comprehensive. Different types of tests are listed below:

5.2 **Written Tests:** A written test may contain any of these types of questions:

- i) *Open-ended question:* This is a question with an unlimited answer. The question is followed by an ample blank space for the response. Although open ended questions provide a superior method of testing than multiple-choice or true-false questions as they allow little or no guessing but they take longer to construct and are more difficult to grade.
- ii) *Checklist:* This question lists items and directs the learner to check those that apply to the situation.
- iii) *Two-way question:* This type of question has alternate responses, such as yes/no or true/false.
- iv) *Multiple-choice question:* this gives several choices, and the learner is asked to select the most correct one. The most commonly used question in training environments is the multiple-choice question. Each question is called a test item. Text of question is called the 'stem' and

incorrect responses are called 'distracters'. When writing multiple-choice questions following points should be kept in mind to build a well constructed test instrument:

- The stem should present the problem clearly
  - Only one correct answer should be included.
  - Distracters should be plausible
  - Option 'All the above' should be used sparingly. If used, an equal number of 'All the above' should be correct and incorrect (distracters). 'None of the above' should also be used very sparingly.
  - Each item should test one central idea or principle. This enables the learner to fully concentrate on answering the question instead of dissecting the question. It also allows the instructor to determine exactly which principles were not comprehended by the learner
  - The distracters and answer for a question should be listed in series. That is, high to low, low to high, alphabetical, longest to shortest, like vs unlike, function, etc
  - Often, test items can be improved by modifying the stem. If a plausible distracter can not be found, then a fewer number of distracters can be selected. Although four choices are considered in the standard for multiple-choice questions they allow a 25 percent chance of the learner guessing the correct answer. If four plausible distracter are difficult to find then choice can be reduced to three plausible distracters. A distracter should never be used just to provide four choices as it wastes the learner's time reading through the possible choices.
- v) *True and false*: True and false questions provide an adequate method for testing learners when two or more distracters cannot be constructed for a multiple-choice question or to break up the monopoly of a long test. In this method, the distracter should be highly plausible forcing the learner to do some kind of analysis to reject it. With a true-false question their odds however get better with a 50 percent chance of guessing the correct answer.
- vi) *Essay*: Essay requires an answer in a sentence, paragraph, or short composition.



To check against the possibility that such multiple choice, true/false, questions really succeed in measuring the ability to not only locate right answer but also the ability to recall and reproduce right answer, it is essential that such questions are formulated very carefully. Essay types of questions are criticized in that its evaluation sometimes tends to be subjective. But essay type test best reflects the ability of comprehension and expression thereof by the learner.

**5.3      *Tests to Check Performance:*** A performance test allows the learner to demonstrate a skill that has been learned in a training program. Performance tests are also criterion referenced in that they require the learner to demonstrate the required behavior stated in the objective. For example, the learning objective 'checking for benching in widening of pavement in embankment' could be tested by having the learners asked a question with embankment slope given in percentage like 20 percent slope instead of expressing in ratio X:Y. 20 percent is flatter than 1:4 and as such does not require benching. The evaluator should have a check that all the performance steps that the learner must perform to pass the test are adequately covered in the test. If the standard is met, then the learner passes. If any of the steps are missed or performed incorrectly, then the learner should be given additional practice and coaching and then retested. There are three critical factors in a well conceived performance test (i) The learner must know what behaviors (actions) are required in order to pass the test. This is accomplished by providing adequate practice and coaching sessions throughout the learning sessions. Prior to the performance evaluation, the steps required for a successful completion of the test must be understood by the learner. (ii) The necessary equipment and scenario must be ready and in good working condition prior to the test. This is accomplished by prior planning and a commitment by the leaders of the organization to provide the necessary resources. (iii) The evaluator must know what behaviors are to be looked for and how they are rated. The evaluator must know each step of the task to look for and the parameters for the successful completion of each step

**5.4      *Listing Entry Behavior:*** For this purpose, a sample of the learner target population should be tested to determine whether their entry behavior or SKAs match with the proposed level of instruction. Such testing is useful to establish if trainer's assumption of learner's threshold knowledge and the starting point of the training program are correct. That is, whether the proposed learners have the needed SKAs to master the terminal learning objective in the training program or must they be taught additional enabling objectives. For example, an instructional program on designing flexible overlays using FWD might instruct several advanced uses of a piece of diagnostic equipment. The instructional plan will be based on the assumption that the

learners have mastered the Benkelman Beam Deflection method from prior experience or training. These basic diagnostic procedures should be tested on the proposed learners to validate the instructional plan assumption. If they have not mastered one or more of the basic diagnostic procedures, then these un-mastered procedures will have to be accounted for in the training plan. Once their present KSAs have been tested, then the tasks to be taught should be tested on a small sample of personnel who have mastered the tasks previously to ensure the proposed test is correct. Finally, a sample of the proposed learners is tested to see if they can pass any portions of the test without any instruction.

## 6 Program Sequence and Structure

**6.1** The last step in the design phase is to determine program sequence and structure to ensure the learning objectives are met. A proper sequence provides the learners with a pattern of relationship so that each activity will have a definite purpose. The more meaningful the content, the easier it is to learn and, consequently, the more effective the instruction. Proper sequencing also helps to avoid inconsistencies in the content of the instruction. When material is carefully sequenced, duplication is far less likely. The presence of duplication often indicates that the program has not been properly sequenced.

**6.2** Some of the techniques and considerations used in sequencing are listed below:

- i) *Job performance order*: It is sequencing the job performance steps in learning program.
- ii) *From simple to complex*: Objectives may be sequenced in terms of increasing complexity.
- iii) *Critical sequence*: Objects are ordered in terms of their relative importance.
- iv) *Known to unknown*: Familiar topics are considered before taking up unfamiliar ones.
- v) *Dependent relationship*: Mastery of one objective requires prior mastery of another
- vi) *Supportive relationship*: Transfer of learning takes place from one objective to another, usually because common elements are included

in each objective. These should be placed as close together as possible so that the maximum transfer of learning can take place

vii) Cause to effect: Objectives are sequenced from cause to effect.

**6.3** If there are a number of objectives, then they should be organized into clusters which have some common characteristics considered appropriate by the trainer to be clubbed for the purpose of imparting learning. The sequencing performed earlier (listing of steps) is the basis for breaking the objectives down into clusters based on the class relationship between them. If the training program is long, then reinforcement also has to be accounted for. One of the behavioral characteristics of learners indicates that not only the rate at which people learn must be accounted for, but also the rate of decay that takes place after an objective is mastered must also be accounted for. To account for this decay factor, reinforcement loops must be built into the instructional process. The decay factor also has to be considered once the learner graduates from the program. If a task is taught in the instructional program and then is not used for some time after the learners return to their duties, then some decay is likely to take place. The remedy for this is to coordinate with the learner's supervisor to ensure the learners perform their newly acquired skills as soon as possible upon returning to the job. In any instructional program, there is usually a wide variety of abilities among the learners. Some will have extensive experience, while others are having only limited experience. Many other variables will affect the progression and productivity of the learners. Provisions must be made to compensate for these differences. In a self-paced course, extra modules can help the learners that are having difficulties. In a class room course, additional instructions, reading assignments, or study halls may be required to keep the slower learners on pace with the other learners. The product of the sequencing step should be a learning map which shows the proposed layout of the objectives. An example of learning objective map showing monitoring of reports generated under MIS is shown in **Annex-4**. Learning process which takes place in the cognitive, affective and psychomotor domain of a learner is explained in **Annex-5**.

**7.** After comprehensive planning of training methodology, the next step is to develop instruction strategies for delivering the training and development activities in most effective manner.



## CHAPTER 11

# INSTRUCTIONAL STRATEGIES

### 1 Strategies for Transfer of Learning

Development phase relates to putting in place learning strategies. The concept of learning in the development phase is translated into effective action. The main instructional setting and media for transfer of learning is chosen in the analysis phase. In design phase, the course content or methods to achieve learning objectives are formulated. Development phase begins with specifying the learning activities that will best assist in the learning process. In this phase, the learning strategies and supporting media that will assist the learners in mastering the objectives are selected. Selection of the proper activities helps trainer to understand what learning is and what activities enhance a particular form of learning. Media and strategy dictionary can be used for seeking assistance for selection of activities. For the purpose of developing learning strategies, foundational concept of learning can be elaborated as below:

- i) Learning is indexed by a change in behavior, which must be translated into observable behavior;
- ii) After learning, learners are capable of performing something that they could not do before the learning experience;
- iii) This change is relatively permanent; it is neither transitory nor fixed;
- iv) The change in behavior need not occur immediately following the learning experience. Although there may be a potential to act differently, this potential may not be translated into a new behavior immediately;
- v) The change in behavior results from experience or practice and
- vi) The experience or practice must be reinforced.

### 2 Process for Learning

**2.1** Learning a subject seems to involve three almost simultaneous processes (i) there is acquisition of new information. Often the information runs counter to or is a replacement for what the learner had previously known. (ii) Learning may be called a 'transformation'- the process of manipulating knowledge to make it fit for undertaking new tasks. Transformation comprises the ways we deal with information in order to go beyond it. (iii) Some type of evaluation takes place by the learner in order to check whether the information and skills are adequate for the task.

**2.2** The stages in the development of instructional strategies are as follows:

- i) Conceptualizing learning strategy;
- ii) Conceptualizing Learning Style;
- iii) Conceptualizing learning process;
- iv) Choosing Delivery system;
- v) Training Media;
- vi) Selection of Instruction Media;
- vii) Reviewing Existing Material;
- viii) Developing the Instructions;
- ix) Synthesizing the Instructions and
- x) Validating the Instructions

### **3 Conceptualizing Learning or Instructional Strategies**

Learning strategies or instructional strategies are the various methodologies used to involve the learners in the training program, such as questioning during lectures, simulation with Computer Based training (CBT), reflection after reading, etc. They are used to obtain the 'learning objectives' or newly acquired behaviors which are expected by the learners when they return back to their jobs. The learning objectives, in turn, are transferred by the 'media' in which instructions are presented. The media can be CBT, self study, classroom, OJT (On the Job Training), etc. In the delivery of course content, optimum mix of different medium must be used. For example, training's learning objective is 'Laying and compaction of Water Bound Macadam (WBM) base course'. Media can be OJT. Trainer's instructional strategies can be to have the learners watch a demonstration in order to get an overall view of the laying and compaction of WBM using stone aggregate, screening, blinding material; their spreading, rolling and setting and drying. OJT can have a question and answer period, observe small group demonstrations, and then receive hands-on practice by actually performing the job. Knowing the type of knowledge, skill, or attitude from the taxonomy, the learning domain can be effectively used in determining the 'learning or instructional strategy'.

### **4 Conceptualizing Learning Styles**

Every learner is unique person. A learning style is a learner's consistent way of responding to and using stimuli in the context of learning. Achieving a solid learning

environment that meets the student's need, rather than their styles seems to be the most important key for effective learning. Learning style as discussed in previous chapter may be referred to for selection of most effective learning style for the given set of pupil and learning objectives.

## 5 Conceptualizing Learning Process

While learning styles show that learners are all different, the learning process shows how and why one learns something. This, perhaps, is even more important than addressing the various learning styles. Although people have a preferred style, they can still learn under almost any style, but if the learning process is not in place, it makes learning a new task or subject almost unachievable. In experiential learning cycle, there are four stages of learning process namely experiencing, interpreting, generalizing and testing which keeps on taking place in a learner in a dynamic cyclic order, each reinforcing the next like experience reinforcing the interpreting and so forth. Learning process thus becomes both iterative and interactive. Not only does new experience or information become a spur to reflection and action, reflection can lead to testing ideas through experience. While developing the instructional strategy, one however needs to take account of choices and deliberate decisions to pick up one and reject other ways of imparting the experiences, interpretations, generalizations and testing to learners.

## 6 Choosing Delivery System

In this step, a trainer chooses the instructional and support material that provides the most effective learning stimulus. Care should be taken not to select materials just because they are available. The purpose in this step is to select learning methods and the media that support them in order to best magnify the learning process. When choosing the media which is best suited to train the objective following considerations may be kept in mind:

- i) *The instructional setting:* What type of setting is required? Is it up to date or does it require modification? If the instructors and learners have to travel to see the working demonstration then what materials must they bring?
- ii) *Media characteristics:* What is the best media for the chosen instructions? How must the media be obtained?
- iii) *Instructional material:* Can it be developed within the proposed budget? What are the constraining factors for producing this material? Will the



technology likely to change before the proposed training material can be produced?

- iv) *Time*: What critical time factors are involved? When and how many learners must be trained by a given time? Is there more than one group to be trained and how closely will each group follow?
- v) *Instructors*: Are they qualified for this type of instruction? Must a 'Train the Trainer' class be given to bring the instructors up to par? How long will it take to bring them up to par? How many instructors are available for this instruction?

## 7 Training Media

Media is the means of communicating and transferring a learning concept or objective to another individual. There are two types of training media within a training program. The first is the instructional setting or major media like class room or lecture hall or site of work. The second is the delivery systems or learning strategies. These are the various instructional methods that take place within the instructional setting. For example, in the class room in the training institute there may be one or combination of learning strategies like lectures, multimedia presentation, programmed instruction, coaching, etc. Training media may be grouped into four major categories (i) Lockstep: It includes class room (Conventional), Boot Camp, Lecture, Telecommunication, Video (ii) Self-Paced : It includes Personalized System of Instruction (PSI), Programmed Learning, Text Instruction, Action Learning (experimental), Workbook, Computer Based Training (CBT), e-learning or Internet Distance Learning (IDL) (Online, Networked, or Web) (iii) Job: It includes Job Performance Aid (JPA), On-The-Job (OJT) (iv) Specialized: Best of class model, Coaching, mentoring.

## 8 Selection of Instruction Media

**8.1** Media instruction chart can be used to determine the optimum mix of training media. For most effective output, use of variety of media singly or in combination are used for transferring learning to others. No one medium is better than other, each medium is best in certain environments. Each type of instructional method however requires certain points to be considered before deciding one or other type of instruction media. Different types of instruction method briefly described as under:

**8.2** **Job Performance Aid (JPA)**: These are the performance aids comprising of list of steps needed for performing a task. These are aids which the trainer feels should be supporting to instruction delivery. Job Performance Aids Includes technical

manuals, flowcharts, or other means of listing the steps for performing a task. Computer Based JPAs include Electronic Performance Support Systems (EPSS), wizards, and Help Systems. Web Based Performance Support Systems (WPSS) can be instantly updated, unlike a technical manual that requires to be printed or to be copied and then distributed. EPSSs are however should not be emphasized for the tasks that requires high psychomotor skills or if the trainees lack the pre-requisite skills. Colour charts are often used to convey specific associations and emotional responses like for example red colour conveys hot, fire, heat in 'mental association', danger/blood/auspicious occasion in 'direct association' and passion, excitement, activity, urgency, speed in 'objective association'. Different colors accordingly are rated for different associative responses and can be used for instructional impact. Chart/flow diagram are effectively used to show the working of equipment. They should be lucid in their explanation, readable from trainees' position and well illuminated to enable learner to follow instruction for any hands on exercised.

**8.3      *Just-In-Time Training:*** Just-in-Time Training as the word suggests conveys the concept of providing training when it is actually needed, rather than on a deferred basis. Such training is usually automated, such as web based or having coaches on stand-by for such needs.

**8.4      *Lecture:*** Although this is the most popular way to present information since it is easy to design and implement, it can also be one of the worst methods as it is passive, and auditory in nature. This method varies from presenting a discourse (extended speech) on a subject to an exchange of ideas. Lectures are generally supported with activities like demonstration, examples, and case studies, quizzes to help learners grasp and understand the subject. When used correctly, lectures can set the stage for deeper learning to take place. Many learners can find this type of training confusing as their comprehension, reading, and listening rates are all quite different. In case a learning program is categorized as discussion, there must be some pre-learning so that an intelligent discussion can take place.

**8.5      *Self Teaching Package:*** This system requires higher motivation coupled with well developed SKAs in the learner to be effective. There are many self learning packages available and can be effectively made use of.

**8.6      *Resident Instruction:*** This system of instruction although takes longer initial development time, they are usually cheaper over the long run if they can be used for an extended period of time. They are employed generally for transfer of new knowledge, concepts and their practical application. They include Computer Based Training (CBT), Text Instruction, Personalized System of Instruction, and Programmed

Learning. Since learning is an individual phenomenon and not a group phenomenon, this method allows the learners to proceed at their own pace. The main disadvantage is that the learners must be motivated to learn on their own. This type of training is suitable if close supervision is not required and the task can be learned by individuals or a group.

**8.7        *Programmed Text Learning:*** Programme Text learning involves features like (i) Learners are exposed to small amounts of information and proceeded from one frame, or one item of information, to the next in an orderly fashion ( linear fashion). (ii) Learners are motivated by incentive like their correct responses can be rewarded and their incorrect responses can be corrected. (iii) Learners are informed immediately about whether or not their response is correct (feedback). (iv) Learners proceed at their own pace (self-paced). Some times trainer diagnoses learner's responses to ascertain learning gaps and decide upon what additional enabling instructions are needed by a learner or group of learners. Linear program is then branched out and accordingly called branching program. Since it attempts to diagnose the learner's response, it usually involves a multi-choice format. After the learners have been presented a certain amount of information, they are given a multiple-choice question. If they answer correctly they move on to the next body of information. If they are incorrect, they are directed to additional information, depending on the mistake they made. Many CBT training courses are based on the concept of linear or branching programmed learning.

**8.8        *Multimedia Computer Programs:*** The multimedia course content being easily up gradable, they are effective where the training subject is low on its shelf life like course on computer software. Also there should be institutional facility available for continuous up gradation of course material.

**8.9        *Computer Aided Instruction:*** This calls for computer specialist trainer who can develop needed software to impart the instruction.

**8.10       *Personalized Instruction or Personalized System of Instruction (PSI):*** It is similar to text instruction, but has the following characteristics (a) Lectures are given infrequently and only for inspirational purposes (b) The course is divided into small units. For each unit the learner gets a study guide that tells the learner what to read and what they must know. After reading the text they answer a set of study questions. The units are small enough so that most can complete the reading and answer the questions in a couple of hours. Other forms of training, such as CBT, activities, etc. may also be used. (c) The learner then takes a unit test. A trainer scores the test and goes over the results, providing feedback and probing to see if the learner



really understands the material. The learner must score at least A+ or 90 percent before moving on to the next unit. There is no penalty for failing in unit test (d) those who fail to score the required percentage marks are coached, given relevant learning assignments, and then retested until they can pass. Once all units have been passed, then the learner graduates from the course.

**8.11      *On-The-Job Training (OJT):*** OJT takes place in normal work settings. OJT can be an excellent training device provided trainer is a specialist in the subject matter and is ready to take fair share of trouble of keeping the learner sufficiently motivated during OJT. The design, development, and implementation of OJT material need the same care and attention as any other training courseware. OJT has one great advantage in that it facilitates quicker transfer of learning as the learner has immediate opportunity to practice learned SKAs on Job and thus training costs are reduced. OJT limitation is that sometime job site may be quite far or may have physical constraints and distractions that could inhibit learning and using expensive equipment for training can result in costly damage and disruption of production schedules. In some cases instructors give class room instructions, and then hand the learners over to the supervisors or coaches.

**8.12      *Boot Camp:*** Boot Camp is an intensive learning environment that accelerates learning and generally employed for accelerated training in the high-tech arena. Boot camps have smaller classes than conventional ones with typically a dozen students or less. Applicants are screened to ensure they have a certain level of knowledge of the subject area, so that other learners are not slowed down in the rapid learning environment. Boot camps are held away from the learner's work environment so there will not be any distractions. Training normally run from one to two weeks, and trains a learner in one subject for 12 to 16 hours a day. The advantage of this type of training is that the organization gets fully up-and-running employee back within a short period of time. The disadvantage of Boot Camp is that learners tend to lose their newly acquired skills if they are not used immediately as the skills are not that well assimilated by the learner as in the case of slower pace of traditional learning programs.

**8.13      *Classroom (Residential):*** This system is used when a large group of learners are required to be taught the same thing at the same time or the task difficulty requires formal training. It should be ensured that all lessons are fully outlined before undertaking classroom instructions. Conventional classes can run from a couple of hours to a couple of weeks and have large group with 20 to 40 learners, who may have varying levels of knowledge and skills. This type of training provides human interaction. If the class is not too large, then the trainer may determine the learners' needs and

instructions can be adapted and adjusted accordingly. The advantages of this system is that the classroom setting permits the use of a wide variety of training methods, e.g. video, lecture, simulation, discussion etc. Also, the environment can be controlled to create a climate conducive to learning and classrooms can accommodate a large number of learners. The main limitations may be increased costs due to travel and staying cost of large number of learners and that the classroom may be quite dissimilar to the job setting. If this type of training is required then there are two options. The first is In-House Training where organization makes use of its own training facility like training institute and in house trainers to company trainers to deliver the instruction. The second option is 'Contract Training', where the trainers are contracted to perform the training at the location as decided by the organization or firm or at the location as may be decided by the trainer or at a separate training site. The two main factors that must be considered when deciding upon In-House or Contract Training are (a) who has the technical expertise to provide the instruction and who can provide the best training at the lowest cost (b) whether training will be lock-step or self-paced. In lock-step instruction everyone proceeds at the same pace, where as self-paced instruction allow the learners to proceed at their own pace.

**8.14      *Coaching:*** A coach can be thought as a one-on-one trainer. He can be a supervisor, co-worker, peer or other outside consultant who is to examine employee performance and provides guidance, feedback, and direction to assure a successful grasp of skills and task completion. The main difference between a coach and a trainer is that coaching is done in real time. That is, it is performed on the job. The coach uses real tasks and problems to help the learner increase his or her performance. While in training, examples are used within the classroom.

**8.15      *Lockstep and Self Pace:*** Self pace is generally considered better than lockstep because it allows each learner to proceed at her or his own pace, but it is more difficult to manage than lockstep and usually requires more instructors because of the wide range of variables that take place within the learning environment. In lockstep all the learners proceed at the same pace. It requires fewer instructors and is more easily managed than self-paced instruction. It is often the medium of choice for one-shot training sessions. The main disadvantage of lockstep is that the pace is set for some hypothetical average learners as in reality there are no average learners to be found. Also, it is hard to meet individual learning requirements and styles.

**8.16      *Mentoring:*** A mentor is a person who confers personal care on the learner and strives to ensure that learner gets the best possible chance to fulfill his career potential. It involves teaching, coaching, and helping to build a high degree

of confidence. Traditionally, a senior employee is paired with a junior employee to prepare him or her for increasing responsibility. But the number of senior employees being limited another method can be devised. If the employee has identified certain skills to be improved, then a Special Project Mentor (SPM) can be assigned. A SPM should not only be an expert with the desired skills, but also someone who enjoys coaching and teaching their special skills.

**8.17      *Telecommunication:*** In this system Instructional television (ITV) links several locations for instructional and conference purposes between remote locations via telecommunication technology. Satellites can cut travel expenses and beam the training to thousands of locations.

**8.18      *Text Instruction:*** In this, a learner is assigned reading material to study. The reading material may be technical manuals, books, or training material produced by the training institute or the trainer. Self-tests are included throughout the training material. Classes and evaluations may also be part of the training material. For making transfer of knowledge more effective they are given a mentor or coach to consult in case they have difficulties with any of the reading assignments. The mentor should hold discussions with their assigned learner on a regular basis.

**8.19      *Workbook:*** It is similar to Text Instruction, except the reading material has activities and exercises to reinforce the learning concepts.

**8.20      *Video:*** Video or multi media systems are generally provided by the outside vendors, followed by specially prepared films. This also includes short visuals to present a problem for solving or discussing. This system is particularly useful in providing instructions relating to skills like communication, presentation technique, time management etc.

**8.21      *Computer Based Training (CBT) or Computer Aided Instruction (CAI):*** CBT has the main advantage in that it provides immediately feedback to the learner and presents various levels of multimedia material until the learner reaches mastery. This system includes educational activities presented in games, drills, and simulations format. Games are used to strengthen the learnt knowledge. A simulation model is a real situation in which the learner accomplishes a real task. It is also self-paced and can be delivered to the learner's desk. Some disadvantages are some learners find it difficult to work with a computer for long periods of time as they find human interaction more appealing to their cognitive faculties. Also, CBT has rather long development times depending upon complexity of the instruction.



**8.22 *E-learning or Internet Distance Learning (IDL) (Intranet, Online, Networked, Enterprise, or Web)*:** This form of learning has recently emerged as one of the most cost effective vehicle for reaching learners remotely. IDL is composed of organizational computer networks that use the Internet, World Wide Web technology, and software for finding, managing, creating, and distributing information. Its main limitations are network bandwidth (size of network's transmittal capacity), and the requirement for each learner to be connected. This type of media is starting to become a favorite with organizations that have workforces in multiple locations and only require simple learning materials. More complex training requirements will have longer development times as it basically turns into CBT training development.

**8.23 *Other Training Methods*:** There are many other types of training methods apart from a few described above. They are briefly described in **Annex-6**.

## **9 Developing the Instruction**

**9.1 *Reviewing Existing Material*:** It is important to review any existing materials to determine if they can be adopted or redesigned into the program. This not only includes material developed in-house, but also material developed by third parties. Whenever possible, the duplication of materials must be avoided to save resources.

**9.2** Only after all the preplanning has been accomplished, is it time to start developing the instructional material. Developing different forms of course content requires a certain amount of skill and art. Strategies for developing course content cover (i) Organizational strategies (broken down to micro level or macro level) to decide the way in which lessons are to be arranged and sequenced. (ii) Delivery strategies to decide how the information is carried to the students i.e. selection of instructional material. (iii) Management strategies involving decisions that help learner to interact with the activities designed for learning. There are many instructional strategy models being employed by the professionals depending upon their preferences. Two models, which are more frequently used, are discussed below.

**9.3 *Robert Gagne's Nine Steps of Instruction*:** Based on above mentioned three strategies, Robert Gagne has developed nine steps of instruction which run in the following sequences: (i) Gain Attention- it involves asking a few introductory questions informing learner of objectives i.e. What learner should expect in the session (ii) Recapitulation of prior information- it involves sharing information which learners are expected to know on the subject (iii) Present information- it involves blending the course material with information recall in previous steps and sequencing the instructions from lower to higher level of difficulty (iv) Provide guidance- it involves

instructions to learner on how he should learn (v) Elicit performance- it involves asking learners to do the task with newly acquired SKAs (vi) Provide feedback- it involves analyzing learner's response to instructions by conducting quizzes, tests etc. (vii) Assess performance- it involves determining whether the lesson has been learnt the way instructor wants learner to learn (viii) Reflection- it involves summarizing the learning and ensuring that the training has brought about the intended changes in SKAs (ix) Enhance retention and transfer- It involves supply of additional practice material, informing about similar problem situation, and also apprising the organization about placement strategies for effective utilization of acquired SKAs by learners.

**9.4 ARCS Approach:** This instruction design process is built on Attention, Relevance, Confidence, Satisfaction (ARCS). These are briefly discussed as below:

- i) *Attention:* It can be gained in two ways (a) by perpetual arousal which makes use of some novel or uncertain event to gain attention of learner. It is similar to introductory remarks in which the topic is opened up with higher level of learner's attention (b) by enquiry arousal which stimulates curiosity among the learner by posing them challenging but interesting questions or problems to be solved. This also stimulates information seeking behavior by posing or having the learner generate questions or a problem to solve.
- ii) *Relevance:* This is done to impart relevance of the material at the same time maintaining high motivation level by using concrete language and examples with which the learners are familiar. They are six major strategies for accomplishing this namely
  - Experience - telling the learners how the new learning will use their existing skills
  - Present Worth - what will be the present worth of the subject matter for the learner or why should he learn the lesson
  - Future Usefulness - what will the subject matter do for the learner tomorrow?
  - Needs Matching - how the training in the lesson will affect the dynamics of achievement, risk taking, power, and affiliation for the learner.
  - Modelling - this strategy includes guest speakers, videos, and inviting the learners who finish their work first to serve as tutors.

- Choice- allowing the learners to use different methods to pursue their work or allowing choices in how they organize it.
- iii) *Confidence*: it is generating confidence that learners will succeed in degree of challenges with which he is going to be presented in the course. The strategies employed for this are providing
- Objectives and Pre-requisites - helping students to estimate the probability of success by presenting performance requirements and evaluation criteria. It should be ensured that the learners are aware of performance requirements and evaluative criteria.
  - Growing the Learners - every learning journey begins with a single step that builds upon itself. This allows a number of small successes that gets more challenging with every step. Learners should understand that there is a correlation between the amount of energy they put into a learning experience and the amount of skill and knowledge they will gain from that experience.
  - Feedback - providing feedback and supporting internal attributions for success.
  - Learner Control - Learners should feel some degree of control over their learning and assessment. They should believe that their success is a direct result of the amount of effort they have put forth.
- iv) *Satisfaction*: learner should get opportunity to use newly acquired skill or knowledge in the real or stimulated setting. Learners should be provided reinforcements that will sustain the desired behavior. If learners feel good about learning results, they will be motivated to learn. Satisfaction is based upon motivation, which can be intrinsic or extrinsic. Some basic rules to be adopted in satisfaction strategy are (a) Do not annoy the learner by over-rewarding simple behavior (b) If negative consequences are too entertaining the learners may deliberately choose the wrong answer. (c) Using too many extrinsic rewards may eclipse the instruction.

## 10 Synthesizing and Validation of Instructions

**10.1** It has to be ensured that when training material and media is developed, the same is synthesized into an integrated program. It should flow as naturally as possible, with each lesson block building the foundation for the next one. Training



material should display variety that is conducive to learning. There should be suitable break between practice periods and instructional periods rather than having all the instruction in the beginning followed by nothing but practice. Time will have to be considered when synthesizing the complete learning program. Developing course content thus follows the principle of 'train and adjust' till course content become the best training material produced.

**10.2** The last step is to validate the material by using representative samples of the target population and then revising the program as needed. The main element of the systems approach to training is revising and validating the instructional material until the learners meet the planned learning objectives. The initial validation will depend upon the complexity of the training material and resources available. The participants can be randomly selected, but they must represent all strata of the target population, bright, average, and slow learners. They should be clearly told what their roles are in the validation process. Learner should know that they are helping to develop and improve the lessons and that they should feel free to tell the trainer what they think about it. The participants should be pre-tested to ensure that the students learn from the instructional material and not from past experience. Adjustment in the procedure can be done as needed to fit the size and complexity of training program, but it should be kept in mind that the closer the validation interval, lesser will be the problems encountered during the training.

**11** After completing the planning work for T&D, the instructional strategies are developed, as brought out in this chapter. The stage is set for taking the learning to participants.

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## CHAPTER 12

# DELIVERING TRAINING AND DEVELOPMENT

## 1 Course Management Plan

**1.1** Implementation phase of training program is similar to phase of work execution after the completing pre-construction exercise like preparation of drawing, design, tender document etc. Success of training program depends upon how well the instructional strategies are finally executed on the ground. Extent to which the training implementation will be successful, however largely depends upon how well the courseware has been prepared. The course management plan is implemented by ensuring that the course content or courseware, class setting, and staff are ready. The learners must be scheduled and notified. Any pre-reading material must be supplied to trainers ahead of time. The training staff may require training (Train-the-Trainer) to perform their roles in the learning process. They must be given time to prepare and rehearse their instruction.

**1.2** An instructor has to prepare himself well before he can transfer effective learning experience to learners. One of the items of implementation phase is the Training Management Plan (TMP), sometimes called the Course Management Plan (CMP). TMP should contain (i) A clear and complete description of the course; (ii) A description of the target population; (iii) Directions for administering the course; (iv) Directions for administering and scoring tests; (v) Directions for guidance, assistance, and evaluation of the learners; (vi) A list of all tasks to be instructed; (vii) Course map or course sequence; (viii) Program of Instruction - how the course is to be taught; (ix) A copy of all the training material, i.e., training outlines, student guides, etc. (x) Instructor and staff training requirements (needed and accomplished) and (xi) Any other documents related to the administration of the course.

## 2 Conducting Training

The training course is brought to life by skillful trainers. In training program's success, it is the trainer's involvement which should be kept in the focus, rather than favorable impressions such as trainer's oratorical skills. Training program is less concerned with platform skills of the trainer and more concerned with skills that facilitate learning. Learning is achieved more effectively by focusing on the learners than on the style of lecturing. Good trainers can bring a poorly designed course to life and make a well constructed course great. Different organization use different

titles like Trainer, instructor, Coach or Facilitator. These titles can be briefly defined as follows:

- i) *Trainer*: Directs the growth of learners by making them qualified or proficient in a skill or task;
- ii) *Instructor*: Gives knowledge or information to learners in a systematic manner;
- iii) *Coach*: Instructs, demonstrates, directs, guides, and prompts learners. He is generally concerned with methods rather than concepts and
- iv) *Facilitator*: Makes it easier for learners to learn. He guides a team towards the results for which it exists to achieve and then the team maintains or improves its competency for continuing to achieve results.

### **3 The Art and Science of Training**

The art of training lies in the repertoire of skills that the trainer uses to train others. It is employing the 'technique' in the delivery system. Some of these skills may come naturally, while others must be practiced and learned. Although most of these skills are based on scientific fact or theory but knowing when and how to use them is more of an art. There are three factors that must happen for a successful learning experience to take place (i) Knowledge: The trainer must know the subject matter. A trainer also provides the leadership, models behavior, and adapts to learning preferences. (ii) Environment: The trainer must have the tools to transfer the subject matter to the learners, i.e. computers and software for computer classes, adequate classroom space, course material such as lesson plans and training aids, etc. The trainer must fuse these training tools with the learning preferences of the learners. (iii) Involvement Skills: The trainer must know the learners. It is important that trainer must really 'know' his/her students. A trainer should have clear idea before proceeding to class room to answer questions like 'what are the learner's real goals for being in the classroom?' 'What are their learning styles?' 'What tools do the learners need to help them succeed?' 'What are those tools that will help me to help the learners succeed in the given learning environment of training? It is the duty of the trainer to coach the learners to become self-directed, intrinsically motivated, goal oriented, and open to learning.

### **4 Involvement Skills**

Involvement skills are the inner tools employed by the trainer as distinct from external



tools such as projectors, lesson outlines, and training. Some of the involvement skills needed by trainers to coach their learners to success are described below:

- i) *Flexibility*: Flexibility is adapting the training program to meet the learners' needs by analyzing and responding to individual learner needs. For example, at on-site training on 'earth work compaction', trainees are told that for embankment construction, earth work should be consolidated under optimum moisture conditions (OMC) with each layer moistened to +1 percent to – 2 percent of OMC. But there are no tools available to demonstrate to check for OMC as per BIS methods of test for soil. This absence of requisite tools may leave the learner with the knowledge of testing requirement but will fall short of skills attainment, rendering the training on earthwork compaction less than adequate. Flexibility demands that determination of OMC by demonstration can be shifted to subsequent day and students are trained on other soil parameters like Liquid Limit, Plasticity Index, deleterious content, gradation etc. This requires involvement, expertise and innovation on the part of trainer. Trainer should be prepared to change the content of training not only before start of training course but also during the training program. Trainer must consistently monitor and evaluate the learners' needs throughout the course of instruction and should not be afraid to change the instructional steps to meet the needs of the learners.
- ii) *Spontaneity*: Although a good training program has structure but it can not be supposed to be executed in a rigid frame work. Spontaneity is the skill to contrive an innovative approach on the spur of moment and is generally a result of feed back from the learner. For example, while on-site training on 'earth work compaction of slope' trainer may demonstrate that the slope of an embankment can be roughly determined even by using a simple thread. Spontaneity also make training program lively and more interactive.
- iii) *Empathy*: Empathy is the ability to perceive another person's view of the world as though they were your own. Empathy differs from sympathy in that sympathy connotes spontaneous emotion rather than a conscious, reasoned response. Empathy with the learners helps trainer to have better understanding of learner's response to the training being imparted. It also opens up learner's inhibitions and limitations to trainer which help trainer in modulating his course

presentation to make it more comprehensible and receivable by the learners.

- iv) *Compassion*: Compassion mitigates stress. Though some stress in the form of arousal is considered good as it helps to motivate the learner. Without some level of stress, task accomplishment is found to be casual and tardy. However, too much stress places an additional burden on most people. Stress level to be employed depends upon the type and kind of learning and learners composition.
- v) *Questioning*: Effective questioning requires that trainer knows what he wants to find out by questioning. He must generate interest of learner in advance so that questions are received by them in de-stressed condition. Using open ended questions to elicit long dialogue is considered more effective in training courses where rigid manual process requirement is not emphasized. Question asked should be short and not confusing. The format of question should be such that the answer should suggest a course of action. Questioning involves three elements i.e. Ask, Pause and Call and generally called APC method. The process of APC runs like (i) Ask the question (ii) Pause to allow learners to think. Normally about 7 to 15 seconds may be given depending upon the difficulty of the question. Looking at the learners will tell if most of them look perplexed or do they look comfortable with the question? The questions asked should help trainer to gauge the effectiveness of his/her instruction. It may be noted that longer pause time and associated quietness in the classroom can be quite disturbing to many, which will normally force them to answer because of the quietness. Frequent questioning is not considered an effective training method (iii) Call on someone to answer the question. Calling on someone after asking the question allows all the learners to think. Even if a learner has no idea of the answer, he is thinking of a way not to be called upon, such as looking busy by taking notes or fidgeting with something.
- iv) *Comprehension*: It Involves transferring the ability to interpret and communicate the meaning of given variables.
- v) *Application*: It implies that learner should be able to use acquired knowledge to solve problems.
- vi) *Analysis*: Analysis requires that a learner should be able to examine

material or relationships of information of constituent parts and to arrive at some solution or response.

- vii) *Synthesis*: It requires the learner should be able to combine elements and parts into a unified entity.
- viii) *Evaluation*: It involves making judgments, appraising, choosing, assessing, measuring, and critically inspecting some idea or object and determining its relative value or worth.
- ix) *Getting feedback*: Feedback can be defined as the ability of the receiver to change and alter the message so the intention of the communicator or sender is understood. Trainer is expected to paraphrase the words or restate the learners/sender's feelings or ideas in his own words, rather than just repeating their words. Feedback need not be in a verbal response, it can well be nonverbal ones. There are five main categories of feedback. They are listed in the order in which they occur most frequently in daily conversations (i) Evaluative: Making a judgment about the worth, goodness, or appropriateness of the other person's statement.(ii) Interpretive: Paraphrasing or attempting to explain what the other persons statement mean (iii) Supportive: Attempting to assist or bolster the other communicator (iv) Probing: Attempting to gain additional information, continue the discussion, or clarify a point (v) Understanding: Attempting to discover completely what the other communicator means by his/her statements.
- x) *Counseling*: Counseling has a powerful, long-term impact on the learners and the effectiveness of the organization. There are two type of counseling - directive and non-directive. In directive counseling, the counselor identifies the problem and tells the counselee what to do about it. Non-directive counseling means the counselee identifies the problem and determines the solution with the help of the counselor. The counselor has to determine which of the two or some appropriate combination, to give for each situation.
- xi) *Positive reinforcement*: Throughout the program of instruction there needs to be continuous or intermittent reinforcements. These reinforcements are boosters which cause the 'operates' (responses) to be learned by the learner. Reinforcement can be in the nature either of rewards (positive) or punishment (negative). However, negative reinforcements have the greatest effect when they are discontinued.



Reinforcements do not always have to be verbal. For example, head nods a form of gestures, communicate positive reinforcement to learners and indicate that trainer is listening.

## 5. The Learning Cycle

Learning generally goes through a process on the following pattern:

- i) The learner starts the training as a beginner. He is very enthusiastic to learn a new skill. He may be somewhat apprehensive because he is about to enter a 'change process'. He needs clear instructions because the task is new, and just a little bit of support to calm the stress of change.
- ii) The level of guidance from the trainer becomes somewhat less so that the learner may experiment with the learning style that works best for him. He has now reached failure a few times in the process. Although the trainer still provides a lot of technical support, emotional support must increase to help keep his confidence high. This normally becomes one of the toughest time for the trainer as he has to provide technical support and emotional support. Technical support is needed so that the failures do not become learned. Emotional support is required so that the learner does not give up. The emotional feedback needs to be specific with positive reinforcement.
- iii) At this point, the learner has become capable of performing his new skill. The amount of guidance drops to just a few pointers so that the learner can experiment with his new skill. But as he is still not sure of himself, the amount of emotional support stays high to help build up his confidence.
- iv) The learner now returns to his job. His supervisor provides little direction and less support so that he can begin to take ownership of his new tasks and responsibilities. He is allowed to perform. He is also encouraged to take on new responsibilities and new assignments. The learning cycle now repeats itself.

## 6 Learning Environment

**6.1 Setting up the Learning Environment:** Generally training environment in the form of class room, hall are in place in the training institute building of the

organization. A few guiding parameters can however be listed as follows:

- i) *Space (square meters) for the classroom:* 1.5 to 1.7 square meters per participant.
- ii) *Configuration of class room:* It should be as nearly square as possible. This will bring people together both psychologically and physically. The room should be at least 3 meter high. This allows a projection screen to be placed high enough so the learners in the rear can see over, not around the people in front of them. The distance from the screen to the last seat of rows should not exceed 6W (W is screen width). Minimum distance between screen to the front row of seats should be 2W (twice the width of the screen). The proper viewing width is 3W (1 & 1/2 width of screen from centerline).
- iii) *Table space per student:* After the PCs are placed (if any) there should be at least 1.0 linear meter (with a depth of 0.6 to 0.8 meter) per learner. This allows them to spread their papers during activities.
- iv) *Type of seating arrangement:* This depends on the learning environment that trainer is trying to obtain and depends upon the room size and dimensions.

**6.2 Psychological Factors in the Learning Environment:** For various psychological factors to be considered in the learning environment, there are number of learning theories like Herzberg's Hygiene and motivational factors, Douglas McGregor's theory X and theory Y, Clayton Alderfer's Existence/Relatedness/Growth (ERG), Vroom's Expectancy and many more.

## 7 Learning Style

A learning style is a student's consistent way of responding to and using stimuli in the context of learning. Various learning style like VAK, Multiple Intelligences etc. may be used for the transfer of instructions. For example linguistic-verbal learners tend to think best via words. For them activities that involve hearing, listening, impromptu or formal speaking, creative writing, documentation can be more effective. For logical-mathematical learners activities involving formulas, graphs, drawings, mind mapping can be used for learning. Using visual, auditory and kinesthetic (VAK) channels will reinforce learning concepts. For avid learners, feeling apprehensive about new learning, clear instructions will be useful whereas for reluctant learners' emotional support to help them build confidence will be required.

## **8 Transfer of Learning**

Transfer of learning is the influence of prior learning on performance in a new situation. If transfer of some of skills and knowledge from prior learning is not transferred, then each new learning situation would start from scratch. The first place to practice transfer of learning is within the classroom. Classroom setting makes it much easier to transfer new skills and knowledge to the job. It provides practice on a variety of tasks that enhances and quickens the learning process. Also, the learners become accustomed to using their newly acquired knowledge and skills in novel situations thus encouraging transfer of learning to the job. There is generally a brief period of slowing down of learning curve when a new set of learning is imparted. However, the variations in the learning environment soon begin to strengthen previously acquired skills and knowledge and should therefore, be encouraged. For example, practicing to design overlay surface using a variety of methods will provide experience of arriving at different results with different stimulus situations making new learning easier. Another example is that greater learning occurs not by re-reading the same text, but by reading another text on the same subject matter. Encouraging transfer of learning in the classroom provides the skills and knowledge for its successful implementation outside of the class. It has however to be ensured that learning so transferred in the session is used upon the job. Transfer of learning is useful only when it is accompanied with a retention plan of newly acquired skills.

## **9 Presentations**

Presentations and reports are ways of communicating ideas and information to a group. But unlike a report, a presentation carries the speaker's personality better and allows immediate interaction between all the participants. A good presentation has: (a) Content: It contains information that people need. But unlike reports, which are read at the reader's own pace, presentations must account for how much information the audience can absorb in one sitting. (b) Structure: - It has a logical beginning, middle, and end. It must be sequenced and paced so that the audience can understand it. Where as reports have appendices and footnotes to guide the reader, in presentation the speaker must be careful not to loose the audience when wandering from the main point of the presentation. (c) Packaging - It must be well prepared. A report can be re-read and portions skipped over, but with a presentation, the audience is at the mercy of a presenter (d) Human Element - A good presentation will be remembered much more than a good report because it has a person attached to it.

## **10 Increasing Effectiveness of Learning Behavior**

The task of transferring new SKAs quite often threatens his self image. This makes



changing his effective behavior which is one of the difficult tasks to accomplish. Affective behavior includes the manner in which the things which lie in the domain of emotions like feelings, values, appreciation, enthusiasm, motivations and attitudes are dealt with. It is, therefore, important to affirm the learner's core value such as moral, religious, family, political etc. A learning which supports his belief and value are more readily accepted by the learner. If a trainer confronts the learners with learning points that suggests they may have acted (in the past) in a foolish or in a dangerous manner, they become resistant to change. For example, if it was told by a learner that to increase the workability of concrete (due to low W-C ratio) he had added sand in the mix, then it may not be proper for the trainer to call this act of his as foolish or dangerous though it certainly exhibited his gross ignorance about the quality aspect of concrete work. No one wants to be told that he did something stupid. Thus, it is important to remind the learner of their "goodness" in order to make various learning points easier for him to digest. The learning will not then be so threatening because thinking about an important value will have affirmed each learner's image of himself or herself as a smart and capable person. Changing affective behavior in respect of transfer of learning in safety related aspects is more difficult yet more important. Making a learner to learn to start earth moving equipment only after checking all the requisite parameters (as per the equipment manual) is more likely to be resisted as it militates against his attitude. However transferring safety learning requires that a learner knows the rules (knowledge), knows how to act (skills), and have a proper attitude for it (affective).

## 11 Lesson Plan Template

Lesson plan template is a task which a trainer sets for himself detailing out what kind of learning he wants to transfer, how this learning will be transferred, what will be the goal achieved etc. in a given training time frame. **Annex-7** illustrates a typical lesson plan template. **Annex-8** illustrates an indicative sample of training programme module designing Flexible Overlays using FWD. The module is prepared by utilizing the concepts of analysis, design and development discussed in the preceding chapters.

## 12 Assessment

At all stages of training and developments, it is necessary to have system of continues assessment and evaluation as described in next chapter.

**CHAPTER 13****ASSESSMENT AND EVALUATION****1 Purpose of Evolution**

**1.1** Assessment and evaluation is an ongoing process throughout the entire learning, training and development program. It is performed during the analysis, design, development, and implementation phases. It is also performed after the learners return to their jobs. Its purpose is to collect and document learner's performance in a training course, as well as on the job. The goal in this phase is to fix problems and make the system better. The most exiting place in teaching is the gap between what the teacher teaches and what the student learns. This is where the unpredictable transformation takes place. The transformation is in the form of mutation of knowledge and skills dividing learner's earlier world view from that of a world view of a trained person. In that sense, the transformation is not passive and defined, rather in the shape of ever evolving spiral of human development. Evaluations help to measure the gap by determining the value and effectiveness of a learning program. It uses assessment and validation tools to provide data for the evaluation. Assessment is the measurement of the practical results of the training in the work environment while validation determines if the objectives of the training goal were met.

**1.2** There are five main purposes of evaluation (i) Feedback - Linking learning outcomes to objectives and providing a form of quality control; (ii) Control - Making links from training to organizational activities and to consider cost effectiveness; (iii) Research - Determining the relationships between learning, training, and the transfer of training to the job; (iv) Intervention - The results of the evaluation influence the context in which it is occurring and (v) Power games - Manipulating evaluative data for organizational politics.

**2 Evaluation Categories**

Evaluations are normally divided into two broad categories (i) Formative Evaluation: Also known as internal, is a method of judging the worth of a program while the program activities are 'forming' (in progress). This part of the evaluation focuses on the process. Thus, formative evaluations are basically done during training period. They permit the learner and the instructor to monitor how well the instructional objectives are being met. Its main purpose is to catch deficiencies so that the proper intervention can take place. This allows the learner to master the required skills and knowledge. Formative evaluation is also useful in analyzing learning materials, student learning

and achievements, and teacher effectiveness. Formative evaluation is primarily a building process which accumulates a series of components of new materials, skills, and problems into an ultimate meaningful whole; (ii) Summative Evaluation: The summative evaluation (also known as external) is a method of judging the worth of a program at the end of the program activities (summation). The focus is on the outcome. During learning and training, a learner undergoes reaction followed by learning. Assessment at this stage is formative evaluation. In the next phase, when learner utilizes his acquired skills and behaviour at work place, he 'performs' and this performance leads to overall 'impact' on the job deliverance. Assessment at this post training phase is summative evaluation. In brief, the reactive evaluation is a tool to help determine if the objectives can be reached. The learning evaluation is a tool to help reach the objectives. The performance evaluation is a tool to see if the objectives have actually been met, while the impact evaluation is a tool to judge the value or worth of the objectives.

### **3 Instruments used in Evaluation**

**3.1** The various instruments used to collect the data are questionnaires, surveys, interviews, observations, and testing. The model or methodology used to gather the data should be a specified step-by-step procedure. It should be carefully designed and executed to ensure the data is accurate and valid.

**3.2** Questionnaires are the least expensive procedure for external evaluations and can be used to collect large samples of information. They should however be very carefully designed and trial tested before using. Trial testing is essential to ensure that the recipients of the questionnaire have understood their operation the way the designer intended. When designing questionnaires, the most important feature is the 'guidance' given for its completion which should be worded in lucid and simple language. All instructions should be clearly stated so that nothing is left for the recipients to imagine.

### **4 Evaluation of Tests**

One of the tools used in the evaluation process is evaluation of tests, also often called 'item analyses'. It is used to 'Test the Test'. It checks and ensures that the testing instruments actually measure the required behaviors needed by the learners to perform a task to standard. It is evaluation of tests. When evaluating the tests one needs to ask the question- 'Do the scores on the test provide information that is really useful and accurate in evaluating student performance?' The item analysis provides information about the reliability and validity of test items and learner performance. Item Analysis



has two purposes first, to identify defective test items and secondly, to pinpoint the learning materials (content) the learners have and have not mastered, particularly what skills they lack and what material still causes them difficulty. Item analysis is performed by comparing the proportion of learners who pass a test item in contrasting criterion groups. That is, for each question on a test, how many learners with the highest test scores (U) answered the question correctly or incorrectly compared with the learners who had the lowest test scores (L). The upper (U) and lower (L) criterion groups are selected from the extremes of the distribution. The use of very extreme groups, say the upper 10 percent and lower 10 percent, would result in a sharper differentiation, but it would reduce the reliability of the results because of the small number of cases utilized. In a normal distribution, the optimum point at which these two conditions balance out is 27 percent. With the large and normally distributed samples used in the development of standardized tests, it is customary to work with the upper and lower 27 percent of the criterion distribution. That means, if the total sample contains 370 cases then the U and L groups will each include exactly 100 cases. There are formats available which can be used for evaluating the tests for arriving at the judgment as to whether a test item is too easy to measure a valid performance standard or whether the test question was worded wrong resulting in every answer being incorrect or some group missed the training (or requires additional training) and level of absorption of difficult concepts by the learners etc. The item analysis thus identifies deficiencies either in the test or in the instruction.

## **5 Evaluation, Effectiveness and Relevance**

Training evaluation is a measurement technique that examines the extent to which the training programmes meet the intended goals. The evaluation measures used depend on the goals and can include evaluation of training content and design, changes in learners, and organizational payoffs. Training effectiveness is the study of the variables that are likely to influence training outcome at different stages (i.e. before, during and after) of the training process. The 'effectiveness' variables have the potential to increase or decrease the likelihood of successful training outcome and are typically studied in three broad categories: individual, training, and organizational characteristics. The training evaluation thus is a methodological approach for measuring learning outcomes whereas training effectiveness is theoretical approach for understanding those outcomes. Training evaluation provides a microview of training results and training effectiveness gives a macroview of training outcomes. Evaluation seeks to find the benefits of training to individuals in the form of learning and enhanced on-the-job performance. Effectiveness seeks to the benefit the organization by determining why individual learned or did not learn. Finally, evaluation

results describe 'what' happened as a result of training intervention. Effectiveness findings tell 'why' those results happened and so assist the training experts to develop prescriptions for improving training programme. Relevance has contextual worth. The first three-levels of evaluation strategies- Reaction, Learning, and Performance are 'soft' measurements. Training programs are however approved in the organization generally on the basis of level four measurements i.e. their returns or impacts. Each level contributes to the effectiveness of the next level. (i) Reaction informs how relevant the training is to the work the learners perform. It measures how well the 'training requirement analysis' processes worked. (ii) Learning informs the degree of relevance that the training package worked to transfer KSAs from the training material to the learners. It measures how well the 'design and development' processes worked. (iii) The performance level informs the degree that the learning can actually be applied to the learner's job. It measures how well the 'performance analysis' process worked. (iv) Impact informs the 'return' the organization receives from the training. The return can be 'soft' like client satisfaction, loyalty to the organization or 'hard' like cost effectiveness or higher output per unit time.

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**CHAPTER 14****DOCUMENTATION FOR HRD AND HRB****1 Retrospection**

Study of growth of highway sector in India since early twentieth century to present day amply highlights the fact that Indian highways have evolved and grown with increasing complexities with their largely successful management whether in the field of technologies and their application, growing multiplicity of players, or in the multiplicity of areas of professional expertise. This achievement could not have been accomplished without corresponding growth and innovation in the field of organizational structure, processes and practices. The competence at individual level in all professional disciplines has also grown contributing at individual, group and organization level for the successful translation of targets set out in Nagpur Plan, Bombay Plan and Lucknow Plan into a reality. Till recently Highway Sector was funded, planned, designed and managed by Central or State Governments. Human resource development and management therefore more or less remained a part of overall organizational management by respective governments with rules, regulations governing HR functions like recruitment, planning, promotions, rewards and punishment, duly codified somewhat in archaic manner, not leaving enough space for the organization to build and develop human resources geared to serve its objectives in most efficient manner. Training and development functions likewise could not be accorded due place and recognition in the overall organization management. This resulted in an organization output which was not uniform across all of its activities but showed efficiency in disaggregated manner largely dependent on the competencies of individual who happen to be entrusted with the job deliverance as can be seen in highly varying quality of road construction and maintenance especially of State highways, MDR and ODRs.

**2 Initiatives for Changes**

**2.1** The mismatch between the demand placed by the technology, environmental considerations, enhanced quality and safety standards, entry of private players, innovative contract management instruments etc. on one side and need for the organization structure to respond such challenges in an effective and efficient manner on the other side forced many State Governments to undertake review for reorienting and reorganizing their departments. With the World Bank assistance, the States of Andhra Pradesh, Gujarat, Orissa, Rajasthan and Tamil Nadu completed their Institutional Development Strategy (IDS) studies and recommended sustainable



improvement to the institutional framework, policies and financing capacities to enable them to undertake effective and efficient management of road network and meet transport demand of its users. At Central Government level such reorganization led to creation of NHAI built on the sound philosophy of remaining lean and thin with teams of highway professionals to manage projects through contractors and consultants. These initiatives though taken in right direction and yielded desired results, the general perception in terms of desired level of comfort, convenience and safety to road users leave much to be desired in terms of HR management and development by the organization to harness full potential of its workforce and apply them in congruence with the organizational intent and objectives. This calls for placing HR development and management on sound footing as a deliberate and conscious management policy. In short, while initiatives taken in this direction are worth appreciation, it can be concluded that lot of work is yet to be done for HRD and HRM.

### **3 HRD and HRM for all Players in Highway Sector**

**3.1** In present day context, besides Government departments, many other important players have emerged in private sector. The list includes Contractors, Consultants, Testing Laboratories, Research Institutes, Concessionaries, Financial Institutions, Equipment Manufacturers, Material Manufacturers, Suppliers and many others. Thus when HRD and HRM requirements are considered, is necessary that all players involved in Highways Sector should initiate the change and transform to effective vibrant organizations to undertake challenges of present and future.

**3.2** There is a need for research and documentation to study evolution of organization structure over the time to enable one to study in the Highway sector, the response to planning, design, management of construction and maintenance during different phases of evolution. Besides different kind of problems faced by them when confronted with growing complexity of highway sector and adoption by organizations to such changes including their break up and development of new organizations, their reorientation, re-engineering etc. should be studied.

### **4 Necessity to Modernize Organizations**

**4.1** There is a need to study slippages in the target achievements with respect to inadequacies in organization structure, coordination among various line and staff function units, decision hierarchy, competence related issues at individual, group and process level, interdepartmental decision process flow and other issues where HRD intervention is called for. Such studies should be a part of organizational development strategy and documented as a conscious exercise on regular basis for taking timely

corrective actions relating to skill and competency related gaps and creating congruence between individual's development with the organization's objectives. There is need for documenting the jobs, roles, goals, duties and responsibilities of various action nodes. There is need to undertake Jobs and their analysis, various tasks and activities to be performed in a given job and process linkages to enable management to assess the training and development need for the job performer and accordingly build training modules to impart right kind of training. This is essential for bridging competence related gaps followed by suitable management of individual for utilization of newly acquired skills and knowledge towards fulfillment of organization's objectives.

**4.2** It is absolutely necessary that all organizations working for Highway Sector should follow the processes and programmes for HRD and HRM as brought out in this document. In fact methodology for study, analysis and training contained herein provides comprehensive guidelines for evolving training and development programme. Depending on available capabilities, studies for HRD and HRM can be done within or by outsource sing. A road map is necessary to appreciate and programme action to be taken for HRD and HRM and thereafter to implement the programme by vigorous monitoring. The importance of such initiatives should be understood with all seriousness. Broadly the organization development follows a path of tackling competence related issues which are generally solved through T&D of individuals and later on when demand placed on the organization can no longer be addressed through competency based solution or when existing organization structure fails to adequately respond to externalities; through restructuring of organization.

## **5 Restructuring of Organizations**

**5.1** For restructuring of organizations not much work on scientific basis has been done in our country. As already brought out only a few studies were done that too due to insistence by World Bank. The critical analysis of implementation of these studies is required to be deliberated and should be made available to all concerned for future guidance.

**5.2** HRD committee is deliberating on "Restructuring of Organizations" and an approach as outlined below is being adopted for drafting a Manual on this subject.

- a) The Vision 2021 document of Ministry of Road Transport and Highways has identified a number of measures to accomplish the vision that need our attention, however the primary concern should be the quality and effectiveness of the Contractors' setup at the field level where the work is actually executed and which eventually decides the quality, speed

and durability of the end product.

- b) During last 50 years or so the organizational structures of government departments have remained more or less same whereas large changes in systems, methods and environment have taken place. So the existing organizational setup of the Employer (including the Engineer) that controls the contractors' activities needs to be looked into so as to make the same effectively cope with the present day functional and delivery requirements.
- c) It is necessary to study model structure of a construction company, which, in a way, deals with the works in a business like manner and aims to be effective and productive in delivery. Ways and means will be found to make it more efficient, while at the same time study some non performers.
- d) Earlier World Bank had studied a few organizations. Perhaps restructuring of organization was carried out in a few states including Andhra Pradesh. Targets set in recommendations need to be compared with actual performance.
- e) With the growing Public Private Partnerships, Consultancy Organizations are increasingly playing an important role and their effectiveness is also crucial. Therefore Organizational aspects of consultants also need to be looked into.

## **6 Preparedness to undertake Training and Development**

**6.1** It is abundantly clear that on the basis of this document comprehensive studies are necessary to initiate training and development of all individuals in different organizations in the Highway Sector. Some organizations have a separate training institute. These training institutes undertake training based on past experience and adhoc feedback for requirements. Generally comprehensive studies to evolve training necessity, target groups, methodology, assessment of gains, feedback in fulfilling objectives of organizations etc., are not done. It is necessary to conduct scientific study to evolve training modules to suit the organization. The implementation is very difficult task particularly because trainers are really not adequately trained. Generally, training should be given by the professionals having background of practice of engineering. Training should not be imparted by an individual not having adequate field /planning/ design experience. Training is not sharing the knowledge gained by books but by knowledge gained by practice. Still these professionals imparting training need training



as trainer. Thus regular training programmes for training of trainers are necessary and this initiative should be taken by NITHE and other similar institutions.

**6.2** On the Skill Development front of workmen, the weakest link is non-availability of trainers. For workmen the trainer should have the knowledge and experience in working for the trade and should demonstrate the work with his own hands. Good workmen sometimes have difficulty to communicate because of lack of education. Therefore for success of the scheme for workmen training, it is absolutely necessary to identify trainers and then train them. Here also institutions like NITHE can take initiative and start training courses for training of trainers for workmen.

**6.3** Training and Development for upgrading the skills are necessary for all individuals involved in Highway Sector. By and large, these involved in Highway Sector, are classified under two categories. These are, (i) Professionals and (ii) Workmen. Professionals include engineers, architects, planners, designers, financial managers, administrators etc. These professionals work for different organizations such as Govt. departments, public undertakings, research organizations, contractors, consultants, concessionaries etc. In broader sense, even contractors, consultants and head of these organizations fall under this category. Other category include, workmen who perform physical work and produce tangible output with their skills. Workmen of different disciplines and categories work for Highway Sector include surveyor, laboratory assistants, supervisors, civil workers (such as masons/carpenters etc.), electricians, mechanics, foremen, machine operators, store assistants etc.

## **7 Training and Development of Professionals**

**7.1** Training and Development of such professionals like Consultants, Contractors etc. is therefore very important and need attention of concerned authorities. Professionals like engineers, join the Highway Sector after acquiring basic engineering or equipment qualification. But Consultants and Contractors do not need such qualification and they start the business in this field like any other business. They all need training but there are no structured training requirements for professionals. Several developed countries like U.S.A, Australia and Japan have norms for obligatory training requirements for engineers for which training courses are conducted accordingly. In our country structured programmes for professional development and certification at different stages of career are yet to finalized and standardized. It is a huge task and there are several impediments.

**7.2** It is felt that Highway Sector should initiate for standardization of structured training programmes. These programmes should cover technical, financial,

administrative, planning, design and several other areas. The HRD committee is working for finalizing of such structured training programmes and syllabus for these programmes. To start with these programmes can be conducted on voluntary basis but with the passage of time these should become obligatory and certification should be done by a national agency. Being a huge and ambitious programme, it will need training institutes, trainers, financing and other infrastructure. The conceptualization and standardization of training needs can be done by IRC under the guidance of Ministry of Road Transport and Highways (MORTH) and with the support of NITHE.

## **8 Policy for Skill Development of Workmen**

**8.1** For implementation of any project, the role of workmen is most important. Unless workmen have requisite skills and their skills are certified, quality work cannot be expected. In fact the construction industry is growing fast and it has to compete internationally. The availability of requisite skills in terms of nature, quality and numbers is a major concern. In 2008, the Ministry of Labour and Employment, Govt. of India, announced the National Policy on Skills Development and of Workmen for Highway Sector. The overall role, mission and objectives of this policy are as follows.

### **a) Role**

- Enhancing an individual's employability and ability to adopt to changing technologies and labour market demands;
- Strengthening productivity, competitiveness, and supporting the process of economic growth;
- Creating employment opportunities by attracting FDI and business expansion on the substrate of availability of relevant skills;

### **b) Mission**

National Skills Development System is aimed at empowering all individuals through improved skills, knowledge and internationally recognized qualifications to enable access to decent employment and promote inclusive growth and ensure India's competitiveness in the global market.

### **c) Objectives**

- Create opportunities for all to acquire skills throughout life and especially for younger people and new entrants to workforce.

- Promote commitment by all stakeholders to invest in skills development.
- Develop high-quality skilled workforce relevant to current and emerging market needs.
- Enable establishment of flexible training mechanisms that respond meaningfully to the characteristics of a wide range of training providers and the trainees' needs.
- Enable effective coordination between different ministries and synergize efforts of the Centre and the States.

d) Coverage

- School/ institution based training.
- Formal apprenticeship.
- Workplace learning and training by industry.
- Adult learning and retraining.
- Non-formal training and learning.
- Informal apprenticeship. .
- Lifelong learning.
- Vocational Education as well as Vocational Training.

**8.2** Based on National Policy, the Ministry of Labour and Employment evolved Skill Development Initiative Scheme. Documents such as Implementation Manual, Guidelines for Selection of Vocational Training Providers under Skill Development Scheme and Course Curricula for Short Term Courses based on Modular Employable Skills were drafted. This documentation by the Ministry covers construction sector but a number of categories of workmen for Highway Sector are not included. The documentation by the Ministry also mentions that the skill level and education attainment of the workforce determines the productivity as well as the ability to adapt to the changing industrial environment. A majority of Indian workforce does not possess marketable skills which is an impediment in getting decent employment and improving their economic condition. While India has large young population, only 5 percent of the Indian labour force in the age group of 20-24 years has obtained vocational skills through formal means whereas the percentage in industrialized countries varies between 60 percent to 96 percent. Only about 25 Lacs vocational training seats are



available in the country whereas about 128 Lacs persons enter the labour market every year. Even out of these training places, very few are available for early school dropouts. This signifies that a large number of school dropouts do not have access to skill development for improving their employability.

The educational requirements at entry level and long duration of courses of the formal training system are some of the impediments for a person to acquire skills for his livelihood. Further, the largest share of new jobs in India is likely to come from the unorganized sector like construction that employs upto 93 percent of the national workforce, but most of the training programmes cater to the needs of the organized sector.

## **9 Workmen Training and Certification in Highways Sector**

**9.1** The most important issue which needs attention in Highway Sector is skill development and certification of workmen, which include Supervisors, Civil Workers, Machine Operators, Mechanics, Electricians, Surveyors, Laboratory Assistants etc. Training and certification of workmen, is difficult for implementation.

**9.2** Following difficulties are noted in training and certification of workmen,

- a) Government at policy level is interested for training and certification of workmen but at implementation level contract management executives are not sensitized. Provisions made in the contract document by different organizations like NHAI, Central PWD etc. with regard to training and certification of workmen are not implemented in real spirit. Contract management authorities are, at times not aware of such provisions. To expect them to be proactive is difficult preposition, if not impossible.
- b) Contractors, sub-contractors, Petty Contractors and Labour Contractors are not interested in training and certification of workmen. They do not gain anything and may even at times feel that after training and certification the workmen can demand higher wages, so it may not be in their (Contractor's) interest to train workmen.
- c) Workmen are interested and desirous for training and certification. They are interested even for upgradation of their skills. But they cannot afford the training financially. The expenditure for trainers and loss of wages during training period are major areas of concern. Besides, job of workmen is temporary and seasonal so they cannot think of leaving the project for the sake of training.

**9.3** It is felt that the best course to empower workmen by training, is to impart the training at the project site. But there is difficulty about financing because funds for training are provided by DGET only if training organization has a training institute with adequate training facilities. Therefore, NGOs and training institutes interested in training of workmen at project site cannot get financial assistances. Policy by DGET needs review particularly for training and certification of workmen at project site. Besides, provision of Workmen Welfare Cess Act is not covering training under its scope. The issue will have to be taken up with State Governments and Central Government, to provide finance for training from funds collected through Workmen Welfare Cess.

**9.4** In order to empower workmen by training and certification, it is necessary that at all major project sites training facilities should be arranged by Employer and Contractor with the help of Training Institutes and NGOs. As most of the workmen are having acquired skill by hands-on training, it will be easy to train them. To start with "gap analysis" should be done of all workmen individually, to ascertain training input required to achieve desired standards. Training can be arranged in the manner that they get class rooms training beyond normal working hours and practical training during the period, they work for the project. After the training is completed, trade tests should be conducted through approved agency of DGET and then certificate issued. For small projects, particularly in rural areas and small towns etc. where contract package size is small, it will be necessary to impart classroom training at a central place and practical training at the respective project sites.

## **10 Financing of HRD and HRM**

**10.1** HRD and HRM are necessity of time and broad outline for action to be taken has already been brought out in this document.

**10.2** For restructuring of organizations earlier initiatives in Government Sector were with World Bank and ADB financing. Similarly proposals can always be framed as per specific requirements for financing by international financing agencies. Besides, restructuring can be a part of cadre review proposals. For Contractors, Consultants and other Private Sector Organizations, the funds for restructuring should not be an impediment as finally the expenditure on establishment is reduced and efficiency increased.

**10.3** Financing of training and development of professionals employed by Government or Private Organizations is generally done from establishment budget with or without specific provision for training. Major organizations like Central PWD

have their own training institutes and expenditure to be incurred for training institutes is part of establishment expenditure. Once the training activity is enhanced, funds for training can also be correspondingly incurred. Thus by and large, funds may not be a constrain for training.

**10.4** Financing of training for Workmen has its own difficulty. The scheme given by Ministry of Labour, Govt. of India has provision of financial assistance to training organizations. Workmen already at the project site are also to be trained and funds are required for such training but no funds are available. In order to make such training financially viable, training institutes and NGO's will have to be funded either by Employer or State Labor Departments, which is collecting Workmen Welfare Cess for construction projects.

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**Annex-1**  
**(Chapter 8 Clause 2.2)**

**Categories of Learning**

Learning can be divided it into three major categories:

- a) Cognitive - mental skills (Knowledge). It includes (a) Verbal Knowledge - factual and propositional knowledge (b) Knowledge Organization - how information and concepts are mentally arranged (c) Meta-cognitive Strategies - allocation and regulation of cognitive resources
- b) Affective - growth in feelings or emotional areas (Attitude). It includes (a) Attitude - attitude about learning, self-efficacy, perception about ability to perform, and goal setting (b) Motivation - motivational disposition.
- c) Psychomotor - manual or physical skills (Skills). It includes (a) Compilation - routine development and procedure linkage (b) Automaticity - ability to perform a task without conscious monitoring and with other tasks.

These three domains are divided into other learning processes. However, these three major domains are important to trainers as although a new behavior might be learned in a variety of methods, it can always be traced back to three major activities.

- a) Cognitive (Knowledge) - mental skills where the brain must be used to perform intellectual tasks.
- b) Affective (Attitude) - best described as "coming from the heart," – values, beliefs system influencing the learning like learner resisting learning which militates against certain principles held by him as sacred. Attitude prompts learner to say that just because he knows something, does not mean that he will act upon it.
- c) Psychomotor (Skills) - physical skills where the body must coordinate muscular activities like applying brake and changing gears simultaneously.

**Annex-2**  
**(Chapter 9 Clause 4.3)**

**An Indicative List of Jobs Description Performed in Highway Sector**

**1 POLICY PLANNING**

- i) Road policy and legal frame work for Road development and maintenance
- ii) Policy for the ownership & responsibility of different road agencies
- iii) Current issues in Highway Sector Development
- iv) Planning and History of Road Development in India
- v) Role of different Categories of roads in the network-NHDP,PMGSY etc.
- vi) Long Term Road Plans, directions, goals, targets v/s achievements
- vii) PPP in Highway Sector
- viii) BOT and its variants
- ix) SPVs, Financial structuring, experience in Centre & States
- x) Model Concession Agreements
- xi) Financing-roads construction and maintenance; road fund; Private Financing; market committee fees; vehicle taxes; Cess on fuel
- xii) Transport modes, characteristics ,policy and coordination
- xiii) Integration of Road transport with other modes
- xvi) Concepts of road assets and its maintenance
- xv) Maintenance of roads-technical aspects; operational capacity issues
- xvi) Evolving Guidelines for Mega projects like PMGSY
- xvii) Corridor Management-Engineering and other non-engineering aspects

- xviii) R&D in Highway Sector
- xix) Planning, Design, Operation of Expressways
- xx) Urban Roads - Characteristics, Special needs
- xxi) Value added facilities on Highway Right of Way
- xxii) Environment Management Plan
- xxiii) Land Acquisition; Resettlement; Rehabilitation Policies
- xxvi) Disaster Management of Highway
- xxv) Creation of central data base of Highway Sector
- xxvi) HRD aspects in Highway Sector
- xxvii) Policy planning of Contracting Industry in Highway Sector
- xxviii) WB, ADB Guidelines and procedure for Highway Projects

## **2 PROJECT PLANNING AT CORPORATE HEADQUARTER**

### **a) Engineering**

- i) Mega Projects-Planning and Design for Construction and Maintenance
- ii) Contract administration-FIDIC Conditions, Standard Bidding Documents
- iii) Dispute Resolution Mechanism in Construction Contract
- iv) Dispute Resolution Mechanism in BOT contract
- v) Dispute Resolution Mechanism in O&M contracts
- vi) Corridor Management-Engineering aspects
- vii) Determination of Highway Capacity, level of service, congestion
- viii) Traffic flow theories, design of signals, intersection, interchange
- ix) Planning and Designing for improving road safety, road signs, pavement marking, crash barriers
- x) Planning and Designing Safety measures at Construction site.



- xi) Developing Project Management for contracting parties, Consultants.
- xii) Planning and Designing procurement procedure of Consultant
- xiii) Preparation of Feasibility Reports/DPR for Mega Projects
- xiv) Planning, Designing and Operation of Expressways.
- xv) Planning and Designing Urban Roads
- xvi) Planning road side amenities, value added services
- xvii) Planning and Designing Environmental Management Plan
- xviii) Planning Disaster Management Plan, Rehabilitation Schemes
- xix) Planning and Design of Toll Complexes
- xx) Database of Axle load; OD Traffic Survey; Traffic Forecasting Technique
- xxi) Planning and Designing Road Drainage System
- xxii) New Material and Construction Technologies
- xxiii) Project Planning according to FIDIC, WB Guidelines
- xiv) Planning for use of IT, GIS, GPS in Highway Sector
- xv) Developing Specifications for Roads and Bridges
- xvi) Developing Standard Data Book
- xvii) Database and Dissemination of Technology, modern trend in Roads and Bridge Construction

**b) Legal**

- i) Highway Legislation: NH Act, NHA Act, CRF Act, MV Act etc.
- ii) Ribbon Development, Encroachment issue.
- iii) Environmental issues
- iv) Land acquisition
- v) Legal framework of Dispute resolution

- vi) Legal framework of WB/ADB guidelines
- vii) Legal framework of BOT, O&M instruments.
- viii) Legal framework of Model Concession Agreement

**c) Finance**

- i) Financing of Road Development ; Road Fund; Private Financing; Cess, Vehicle Taxes etc.
- ii) Financing maintenance of roads; concept of road asset
- iii) Procurement of Consultants
- iv) Value added services on ROW of expressways
- v) Road user cost; Cost benefit of augmenting Highway Capacity
- vi) Toll Collection
- vii) Financial aspect of WB/ADB guidelines

**3**

**PROJECT EXECUTION**

**a) Design and Estimation**

- i) Designing Mega Road and Bridge Projects
- ii) Cost estimation of Road and Bridge Projects
- iii) Design of Signals, Intersections; Estimation of Traffic Flow
- iv) Design of Road Signs, Safety Devices, Pavement Markings
- v) Developing Project Management System for Field Staff
- vi) Preparation of DPRs
- vii) Pavement Design - Flexible and Rigid Type
- viii) Design of High Embankment/Ground Improvement Technique
- ix) Design of Soil Reinforcement Structures
- x) Geo-technical and Landslide Investigation
- xi) Geometric Design of Roads of different categories
- xii) Designing Expressways

- xiii) Computer aided Highway Design
- xvi) Designing Hill Roads
- (xv) Designing Urban Roads
- xvi) Designing Bridges/Flyovers/ROBs/RUBs
- xvii) Advanced Analysis of Roads and Bridge Structures
- xviii) Designing Wayside Amenities on Expressways
- xix) Designing Toll Plaza
- xx) Bridge Inspection and Diagnosis of Distress Observed
- xxi) Design of Road Drainage
- xxii) Developing Schedule Items of New Material and New Technology
- xxiii) Developing SOQ based on MORTH & MORD Specifications
- xxvi) Quantity Surveying/Estimation based on Standard handbook
- xxv) Incorporating IT, GIS, GPS in Quality Control, Workmen Computation

**b) Contract Document Preparation**

- i) Making Concession Agreement on BOT/BOOT etc. using Guidelines issued from Head Quarter
- ii) Making Contract Document for Mega Projects like PMGSY
- iii) Preparation of Bidding Document incorporating FIDIC/ADB/WB Guidelines
- iv) Preparation of Bidding Document for procurement of Consultants

**c) Execution of Work**

- i) Project Management
- ii) Construction Management by Contracting Agency
- iii) Safety Management
- iv) Payment/Cash Flow Management



**d) Contract Management**

- i) Enforcing Contract Conditions in Project Execution
- ii) Contract Administration
- iii) Dispute Resolution

**e) Quality Assurance**

- i) QA & QC at Work Site
- ii) ISO System
- iii) Testing of Material Process Product Equipment

**f) Machinery and Equipment**

- i) Productivity Management of Machinery and Equipment
- ii) Construction Equipment and Management

**4**

**MAINTENANCE OF ASSETS**

**a) Planning and Design**

- i) Planning and Designing Maintenance Sequences of Roads/ Bridges
- ii) Pavement Evaluation
- iii) PMS,BMS,HDM-4,HDM-III
- iv) Bridge Inspection and Performance Evaluation
- v) Road Drainage Maintenance

**b) Execution**

- i) Maintenance of Roads-Routine, Special,
- ii) Maintenance of Bridges-Routine, Special
- iii) Maintenance of Drainage System

**c) Evaluation and Review**

- i) Maintenance Performance Evaluation

**Annex-3**  
**(Chapter 9 Clause 8.4)**

**Analysis Template**

**1 System Overview**

Purpose: To enable T&D analyst and developer to gain an understanding of the organization or department and its various input-output systems where various learners are engaged. Such understanding of the system will help analyst as to where he should work from. The template will address following queries.

- a) Organization/Department/firm/ wing of organization or firm:
- b) Date:
- c) Department Supervisor:
- d) Summary of Activities learners are engaged in:
- e) Inputs-Process - Output of the system in which learners are engaged in:
  - i) Input:
    - People working in the system like in Design Unit
    - Material Used for processing the activities
    - Technologies Used for processing the activities
    - Important Time Factors for processing the activities
  - ii) Process:
  - iii) Output:
- f) Problems as perceived to exist in the system:
- g) Background of Proposed Learners:
  - i) Average Educational Level
  - ii) Average number of years of experience

- iii) Average number of years employed by the organization/firm
- iv) Required entry level skills and education
- v) Job requirements verses learner's skills
- vi) Language or culture differences of learners
- vii) Motivations of learners
- viii) Physical or mental characteristics of learners
- ix) Specific interests or biases of learners

## 2 Job List Instrument

Purpose: Provides a list of all jobs required by the system to produce output for example say Design unit where the learner is working may have Draftsman, junior engineer, senior engineer, computer operator, for producing structural design and drawing with each employee performing well defined set of tasks constituting their job function.

- a) Department/ organization/firm:
- b) Input Output System of learner
- c) Date
- d) Analyst
- e) Department Supervisor

Job Title	Brief Job description	Process Linkages to other jobs	Remarks

## 3 Job Description Instrument

Purpose: To gain an understanding of obligations and responsibilities assigned to different job performers in the system of an organization/firm. The detailing of requirements of the job will give an idea about the HR processes i.e. type, quantum,



and coverage of training and whether the training will meet the end objective or skills will have to be hired.

- a) Organization/firm
- b) Input-output system where the job is located like ' landscaping wing' of National Highways Authority etc
- c) Date
- d) Analyst
- e) Department Supervisor
- f) Job Title
- g) Purpose and Description of the Job
- h) Type of Supervision required
- i) Number of people supervised
- j) Skills, Education, and Experience required
- k) Special job demands like working conditions, travel, hazards, etc

#### 4 Task Inventory Instrument

Purpose: Each Job requires certain tasks to be performed. Task Inventory will list out such tasks to decide upon the most effective T&D tools for the performance of those tasks.

- a) Department:
- b) Date:
- c) Analyst:
- d) Department Supervisor:
- e) Job Title:
- f) Brief Job Description:

Task Number	Task

## **5 Task Survey Instrument**

Purpose: As each task for a given job description calls for different level of attention, has different level of criticality and different frequencies of performance of task, task survey provides a tool to the analyst to plan and develop training program most suited for that job.

The table below contains a list of tasks relating to the job. The table may be filled under three parameters of frequency, criticality and training required.

- a) The frequency of the task i.e approximate number of times that it is performed hourly, daily, weekly, etc. For example: 4 times a day.
- b) The criticality of each task for the successful performance of the job - There are 4 levels: 1) Not important 2) Somewhat important 3) Important 4) Most important
- c) The amount of training required to reach proficiency based on historical data or experience-in hours.
  - i) Organization/firm
  - ii) Input-output system/department/wing of the organization
  - iii) Job Title
  - iv) Brief description of job
  - v) Name

## **6 Employee Survey Instrument**

Purpose: Feedback on training requirement with a view to improve upon training program.

- a) Job Title
- b) Brief description of Job
- c) Type of training received. For each type of training listed below, check the box that applies to the employee giving the feed back.
- d) What type of training would the employee recommend to someone for efficient performance of job similar to his job?
- e) Whether employee feels that he requires further training, and if so, what kind of training?

Type of training received	Could not have done without it	Of great help	Somewhat helpful	No help	Did not receive
Apprenticeship					
Employer training program					
On the Job Training					
Help from coworkers					
Instruction Manuals					
Job Aids					

- f) Does employee thinks that his organization offers:
- i) Too much training
  - ii) A good mix of training
  - iii) The wrong types of training
  - iv) Too little training
  - v) Too much formal training and not enough on-the-job training
  - vi) Too much on-the-job training and not enough formal training
  - vii) Any other not covered above
- g) Employees comment as to how he would like to see his organization's training program dovetailed with his job.

## 7 Supervisor and Manager Training Survey Instrument

Purpose: Manager, associated with the target achievements set by the organization for his wing/unit should be in position to suggest the ways to improve the training program and on his staff training requirements.

- a) What type of training does he and his employees require?
- b) How the manager perceives the break-up of 100 percent of total training efforts for himself and his staff, which he feels should be apportioned of the total training mix?
  - i) Each column should add up to exactly 100 percent.



- ii) Assign no percentage to topics in which he does want training.
- iii) For the rows listed as "Other," enter the type of training that he feels is needed.

	For yourself	For staff directly reporting to you	For staff that report to your direct subordinate.
1. Leadership			
2. Computers			
3. Time Management			
4. Soft skills			
5. Task management			
6. Personnel management			
7. Other			
8. Other			
9. Other			
10. Other			
<b>TOTAL</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

- c) Does he think that his organization offers?
- i) Too much training
  - ii) A good mix of training
  - iii) The wrong types of training
  - iv) Too little training
  - v) Too much formal training and not enough on-the-job training
  - vi) Too much on-the-job training and not enough formal training
  - vii) Any other, not covered above
- d) Any comments on what in his opinion can be done to improve training program:

## 8 Task Selection Instrument

Purpose: To determine if a task should be trained. The first four sections are used to

determine if it should be trained. The last two sections will be of aid in selecting the type of training. Depending upon the task, not all questions require an answer.

**TASK: For example, lifting a flyover segment and placing in position.**

**a) Required by Law, Contract, Safety Factors, Organizational Requirements**

- i) Is the training mandated by the Occupational Safety and Health Act? **Yes**
- ii) Is training required to achieve safety standards as contained in contract? **Yes**
- iii) Is there a chance that someone may hurt or that damages may occur if it is not trained? **Yes**
- iv) Is training needed to ensure that employees want of performance standards do not lead to contractual/legal complication for the firm/organization? **Yes**
- v) Is training required to meet firms/ organization's vision or mission? **Yes** – To, provide a safe working environment for all personal and safety to public.
- vi) Is the training required to meet organizational goals or objectives? **No**

Generally, any 'yes' answers is this section requires training or another performance initiative. **Analyst's recommendation: Training must be provided.**

**b) Use of Another Performance Initiative**

- i) **Is there another solution, such as a job performance aid?** No, as the activity is critical and has to be repeated frequently. It is suggested to have class room presentation and activity sequencing learning which will be followed by on-job demonstration.
- ii) **Can people be hired that have already been trained?** Yes, but it will be preferred to have the training given by those engaged on the job on- site.
- iii) **To what extent can the task be learned on the job?** Training will only be provided to ensure that trainees have assimilated all the

required sequences of activities, safety precaution requirement of each and every step so that they know how to operate safely. The rest of the training will be provided on the job.

- iv) **Are the demands (perceptual, cognitive, psychomotor or physical) imposed by the task excessive?** They require good perception (must be able to lift 40 tonne segment to a height of 10-12 meters and place them in sequence in air followed by final placement on the pier.) and they require some manual dexterity to manipulate the controls. Also, they are required to stand for a long period. They are also required to maintain calm and composure during prolonged period due to slow but accurate placement of segment.
- v) **Are other performance interventions required?** None at this time.
- vi) **Is there another creative solution that better meets the organization's needs (brainstorming required to correctly answer this question)?** Not at this time.

Another performance solution is generally recommended if it is cheaper or if it better meets the organization needs. **Analyst's recommendations: A class room training with a mix of teaching and presentation followed by on job demonstration and then practice and evaluation.**

#### c) Risks and Benefits

- i) What will happen if we do not train this task? **Accidents likely to occur**
- ii) What are the benefits if we train this task? **We will meet safety requirements.**
- iii) How critical is the task? **Very Critical.**
- iv) What is the consequence if the task is performed incorrectly? **Accidents likely to occur.**

Identifying the risks and benefits helps in arriving at the correct solution. **Analyst's recommendations: Training required**

#### d) Task Complexity

- i) How difficult or complex is the task? **Moderately complex.**



- ii) How often is the task performed during a specified time frame (e.g, daily, weekly, monthly, yearly)? **Throughout the day.**
- iii) How much time is needed to perform this task? **Normal task completion is about 30 to 60 minutes; however it is performed throughout the day on a continuous basis.**
- iv) What behaviors are used in its performance? **Coordinated movement of material with other personnel, continuous review of activity sequence with other personal, alignment technique using basic math.**
- v) How critical is the task to the performance of the job? **Extremely critical.**
- vi) What information is needed to perform the task? **Segment number, its location sequence in the loading span.**
- vii) What is the source of information? **Communication with casting yard, job work plan, identification mark on the segment.**

Generally, complex and frequently performed tasks require training, while simpler and infrequently performed tasks require other performance solutions (such as job performance aids).

#### **e) Collective (team considerations)**

- i) Does execution of the task require coordination between other personnel or with other tasks? **Yes, must work in tandem with control operator to move the segment at the designated location accurately.**
- ii) If it is one of a set of collective tasks, what is the relationship between the various tasks? **The segment lifting and placing in alignment is followed by the task of accurate abutting of segment, temporary fastening of segment, placing of segment on pier and post tensioning of segment.**

Identifying the collective degree of the task plays important role in determining the forward and backward activities requirements to which conformance of the performance standard of task to be trained should meet.

**f) Requirements for Training**

- 2.2.1.1 What are the performance requirements? **Segment brought from the casting yard on tractor trawler truck should be fastened, lifted and placed in the assigned sequence at assigned height in assigned alignment with adjacent segment.**
- 2.2.1.2 What prerequisite skills, knowledge, and abilities are required to perform the task? **Basic math skills, fastening, lifting using machine operation, ability to convey clear directions to other fellow technician/workers and abilities to understand and transfer directions received from engineer, motor operator and other fellows. Assimilated knowledge about the criticality of task and safety standards to be followed.**
- 2.2.1.3 What behaviors distinguish good performers from poor performers? **Accuracy and being able to operate safely.**
- 2.2.1.4 What level of task proficiency would be expected by the department following training? **Being able to conduct segment lifting operation safely, efficiently and in a synchronous manner.**

**9 People, Data, Things Instrument**

Purpose: It helps to understand the main function of the job. Jobholder performs the tasks assigned to him. Such tasks may have a focus either on people like management, or data like design engineer or things like operating a bulldozer. Performance deficiency is likely to result if there is a mismatch between the employee's preference and the job he is performing. For example, if employee shows preference for design (data) but he is put on site execution (thing) then his performance may suffer because of mismatch between employee's and job focus. Although most jobs entail that the jobholder works with all three functions, there is usually one or two functions that the job extensively focuses upon. Listing all job responsibilities under one of the three categories will provide the information as to what major role an employee will be expected to fulfill -a people person, a data person, or a thing person.

Instructions: Table shown below, contains a number of verbs to assist the analyst in selecting the correct category:

**Annex-5**  
**(Chapter 10 Clause 6.3)**

## Learning Domains Taxonomy

**1 The Three Types of Learning:** There is more than one type of learning. A committee of colleges, led by Benjamin Bloom, identified three domains of educational activities:

**Cognitive:** mental skills (Knowledge)

**Affective:** growth in feelings or emotional areas (Attitude)

**Psychomotor:** manual or physical skills (Skills)

Domains can be thought of as categories. Trainers often refer to these three domains as KSA (Knowledge, Skills, and Attitude). This taxonomy of learning behaviors can be thought of as "the goals of the training process." That is, after the training session, the learner should have acquired new skills, knowledge, and/or attitudes. The committee also produced an elaborate compilation for the cognitive and affective domains, but none for the psychomotor domain. This compilation divides the three domains into subdivisions, starting from the simplest behavior to the most complex. The divisions outlined are not absolutes and there are other systems or hierarchies that have been devised in the educational and training world.

**2 Cognitive Domain:** The cognitive domain involves knowledge and the development of intellectual skills. This includes the recall or recognition of specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills. There are six major categories, which are listed in order below, starting from the simplest behavior to the most complex. The categories can be thought of as degrees of difficulties. That is, the first one must be mastered before the next one can take place.

Category	Example and Key Words
a) Knowledge: Recall data or information.	<p>Examples: Describe pre-requisites of site clearance activities from memory or local land acquisition procedure</p> <p>Key Words: defines, describes, identifies, knows, labels, lists, matches, names, outlines, re-call, recognizes, reproduces, selects, states.</p>



b) Comprehension Understand the meaning, translation, interpolation, and interpretation of instructions and problems. State a problem in one's own words.	<p>Examples: Rewrite the principles of road alignment; Explain in your own words the steps for comparing different alternatives of road alignment.</p> <p>Key Words: Comprehends converts, defends, distinguishes estimates, explains, extends, generalizes, give Examples, infers, interprets, paraphrases, predicts, rewrites, summarizes, and translates.</p>
c) Application: Use a concept in a new situation Applies what was learned in the classroom into novel situations in the work place.	<p>Examples: Use rate analysis to compute rolling cost of a newly laid road surface on per day and per square meter basis.</p> <p>KeyWords: applies, changes, computes, constructs, demonstrates, discovers, manipulates, modifies, operates, predicts, prepares, produces, relates, shows, solves, uses.</p>
d) Analysis: Separates material or concepts into component parts so that its organizational structure may be understood. Distinguishes between facts and inferences.	<p>Examples: Troubleshoot a piece of equipment by using logical deduction. Recognize logical fallacies in reasoning. Gathers information from a department and selects the required tasks for training.</p> <p>Key Words: analyzes, breaks down, compares, contrasts, diagrams, deconstructs, differentiates, discriminates, distinguishes, identifies, illustrates, infers, outlines, relates, selects, separates.</p>
e) Synthesis: Builds a structure or pattern from diverse elements. Put parts together to form a whole, with emphasis on creating a new meaning or structure.	<p>Examples: Write a technical paper on completed work project for a seminar.</p> <p>Integrates training from several sources to solve a problem. Revises and process to improve the outcome.</p> <p>Key Words: categorizes, combines, compiles, composes, creates, devises, designs, explains, generates, modifies, organizes, plans, rearranges, reconstructs, relates, reorganizes, revises, rewrites, summarizes, tells, writes.</p>
f) Evaluation: Make judgments about the value of ideas or materials.	<p>Examples: Select the most effective road alignment. Hire the most qualified candidate. Explain and justify delay in project. .</p> <p>Key Words: appraises, compares, concludes, contrasts, criticizes, critiques, defends, describes, discriminates, evaluates, explains, interprets, justifies , relates, summarizes, supports.</p>
<b>3. Affective domain:</b> This domain includes the manner in which we deal with things emotionally, such as feelings, values, appreciation, enthusiasms, motivations, and attitudes. The five major categories listed the simplest behavior to the most complex:	
Category	Example and Key Words
a) Receiving Phenomena: Awareness, willingness to hear, selected attention.	<p>Examples: Listen to others with respect. Listen for and remember the name of newly introduced people.</p> <p>Key Words: asks, chooses, describes, follows, gives, holds, identifies, locates, names, points to, selects, sits, erects, replies, uses.</p>

(b) Responding to Phenomena: Active participation on the part of the learners. Attends and reacts to a particular phenomenon. Learning outcomes may emphasize compliance in responding, willingness to respond, or satisfaction in responding (motivation).	<p>Examples: Participates in training question new ideals, concepts, models, etc. in order to fully understand them; Know the safety rules and practices them.</p> <p>Key Words: answers, assists, aids, complies, conforms, discusses, greets, helps, labels, performs, practices, presents, reads, recites, reports, selects, tells, writes.</p>
(c) Valuing: The worth or value a person attaches to a particular object, phenomenon, or behavior. This ranges from simple acceptance to the more complex state of commitment. Valuing is based on the internalization of a set of specified values, while clues to these values are expressed in the learner's overt behavior and are often identifiable.	<p>Examples: Demonstrates sensitivity to local sentiments while undertaking site clearance operation; demonstrate empathy to employee's response to certain instructions.</p> <p>Key Words: completes, demonstrates, differentiates, explains, follows, forms, initiates, invites, joins, justifies, proposes, reads, reports, selects, shares, studies, works.</p>
(d) Internalizing values (characterization): Has a value system that controls their behavior. The behavior is pervasive, consistent, predictable, and most importantly, characteristic of the learner. Instructional objectives are concerned with the student's general patterns of adjustment (personal, social, emotional).	<p>Examples: Shows self-reliance when working independently. Co-operates in group activities (displays teamwork). Uses an objective approach in problem solving. Displays a professional commitment to ethical practice on a daily basis. Revises judgments and changes behavior in light of new evidence. Values people for what they are, not how they look.</p> <p>Key Words: acts, discriminates, displays, influences, listens, modifies, performs, practices, proposes, qualifies, questions, revises, serves, solves, verifies.</p>

**4.Psychomotor:** The psychomotor domain includes physical movement, coordination, and use of the motor-skill areas. Development of these skills requires practice and is measured in terms of speed, precision, distance, procedures, or techniques in execution. The seven major categories listed progresses from the simplest behavior to the most complex:

Category	Example and Key Words
a) <b>Perception:</b> The ability to use sensory cues to guide motor activity. This ranges from sensory stimulation, through cue selection, to translation.	<p>Examples: Adjust theodolite level by looking at the position of water bubble.;</p> <p>Detect deficiency in the rolled and compacted Bituminous Concrete Road surface.</p> <p>Key Words: chooses, describes, detects, differentiates, distinguishes, identifies, isolates, relates, selects.</p>
b) <b>Set:</b> Set means readiness to act. It includes mental, physical, and emotional sets. These three sets are dispositions that predetermine a person's response to different situations (sometimes called mindsets).	<p>Examples: Know and act upon a sequence of steps in a manufacturing process; Recognize one's abilities and limitations;</p> <p>Show desire to learn a new process (motivation).</p> <p>Key Words: Begins displays, explains, moves, proceeds, reacts, shows, states, volunteers.</p>

c) Guided Response: The early stages in learning a complex skill that includes imitation and trial and error. Adequacy of performance is achieved by practicing.	<p>Examples: Perform a mathematical equation as demonstrated; Follow instructions to build a model; Respond to hand-signals of instructor while learning to operate a forklift.</p> <p>Key Words: copies, traces, follows, react, reproduce, responds</p>
d) Mechanism: This is the intermediate stage in learning a complex skill. Learned responses have become habitual and the movements can be performed with some confidence and proficiency.	<p>Examples: Use MS Project to find critical path; Repair a leaking tape;. Drive a car.</p> <p>Key Words: assembles, calibrates, constructs, dismantles, displays, fastens, fixes, grinds, heats, manipulates, measures, mends, mixes, organizes, sketches.</p>
e) Complex Overt Response: The skillful performance of motor acts that involve complex movement patterns. Proficiency is indicated by a quick, accurate, and highly coordinated performance, requiring a minimum of energy. This category includes performing without hesitation, and automatic performance. For example, players are often utter sounds of satisfaction or expletives as soon as they hit a tennis ball or throw a football, because they can tell by the feel of the act what the result will produce.	<p>Examples: Maneuver quickly a car into a tight parallel parking spot; Operate a software quickly and accurately.</p> <p>Key Words: assembles, builds, calibrates, constructs, dismantles, displays, fastens, fixes, grinds, heats, manipulates, measures, mends, mixes, organizes, sketches.</p> <p>NOTE: The Key Words are the same as Mechanism, but will have adverbs or adjectives that indicate that the performance is quicker, better, more accurate, etc.</p>
f) Adaptation: Skills are well developed and the individual can modify movement patterns to fit special requirements.	<p>Examples: Perform a task with a machine that it was not originally intended to do (machine is not damaged and there is no danger in performing the new task).</p> <p>Key Words: adapts, alters, changes, rearranges, reorganizes, revises, varies.</p>
g) Origination: Creating new movement patterns to fit a particular situation or specific problem. Learning outcomes emphasize creativity based upon highly developed skills.	<p>Examples: Construct a new theory; Develop a new and comprehensive training programming.</p> <p>Key Words: arranges, builds, combines, composes, constructs, creates, designs, initiate, makes, originates.</p>



**Annex-6**  
**(Chapter 11 Clause 8.23)**

### **Various Types of Training/System Methods**

- 1        Action learning sets: Involve a group of people convening to bring to the set real work problem, supporting and challenging each other. Each participant work on his or her problem between set meetings and brings new information and solution back to group. Typically group meets once a month for half a day and for a period of six months. Learning is through questioning.
- 2        Action maze: Similar to case study, but uses printed instructions to guide through to pre-determined conclusions. It is called maze because choices and options are offered at certain stages- rather like pathways. Discovery of preferred paths are the main outcome of this exercise. It involves learning through incorrect decision making.
- 3        Brainstorming: Creative ideas from participants. Group are allowed to submit ideas or suggestions and none are rejected. No discussion and value judgments are made at this stage. All ideas can be rearranged and assessed later. It is good fun and very creative, allowing a lot of participant input with no discussion. Participants feel sense of ownership of ideas.
- 4        Bulletin board/newsgroup/computer conferencing: provides specialist information and discussion on specified topics. Very interactive as one question posted can be responded by many other people.
- 5        Business game simulations: Dynamic exercises or case studies involving 'coming to terms' with a situation, then managing via a set of imposed decision. It offers practice in management in decision, observation, analysis etc. It stills confidence.
- 6        Buzz groups: small groups, often formed after an input session, answer a set question or complete a set task and report back to trainer or the rest of the group. It helps in rapid gain in knowledge. Good group support engendered.
- 7        Case study: Examination of events or real life situation, usually aimed at learning by analyzing detailed material and defining solutions to a problem. It provides god setting for discussing various problem solving approaches.
- 8        CDROM/CD writes: Allows trainees to present their own views and submission for checking by tutor at his convenience. It is an effective self-motivating learning. Retrieval of text, picture makes learning process interactive and computer oriented.

- 9** CBT: learner-managed coverage of programmed material, usually involving keyboard and screen. Compatible hardware and software needed. CBT offers work place simulations incorporating sound, animation, stills, video clips thus offering learners an insight to applications in practice.
- 10** Computer Supported Collaborative Learning (CSCL): Involves hand-on experiences for learners via a computer supported environment. Simulation environment can be located anywhere on internet. Gains through shared understanding.
- 11** Continuing professional development (CPD): Enables individual to systematically build and improve their personal profile in a given profession. Enables individual to broaden their knowledge, skills and qualities necessary for carrying out their professional and technical duties.
- 12** Discovery learning: Learning without a teacher but in a controlled set-up, and under supervision. Offers challenges and build confidence as learners master new skills. Time constraint does not affect learning process.
- 13** Discussion: Free exchange of information, opinions, etc. A 'controlled' discussion may follow a planned path with leader controlling the agenda. Individual participation may be affected by group composition. Promotes group cohesion.
- 14** Distance education (DE): Courses offered from a distance. Nowadays they make use of information and telecommunication technology (ICT). Enables access to education for those who are unable to attend conventional courses.
- 15** Exercises: Carries out a particular task along prescribed lines. Often a test of knowledge earlier communicated. Highly active form of learning; satisfies needs for practice to apply knowledge or develop skills.
- 16** Experiential learning: A cyclical process whereby learners gain experience and then reflect on it. Individual carry out tasks and then in small groups describe and recall their 'experiences' at the level of relationships, emotions, and feelings. New ideas emerges that can be tested in other environment.
- 17** Films and videos: Visual lectures, often in dramatized form. Expensive unless produced at mass scale like for Open University. Dramatized version of lecture enhances motivation.
- 18** Fish bowl exercise: An inner circle of people doing the exercise are observed by an outer circle-hence 'fish bowl'. Inner and outer circle than swap. Allows observational skills to improve.

- 19** Instructions: Formula based on 'teaching' session. Follows steps- tell, show, do, and review process and results. Design/balance of session is important. Confidence is built by mastery and linkages of steps. Provides vehicle for feedback to instructor.
- 20** In-tray methods: Often used in time management training. Uses a simulated in-tray with a just a few or many tasks, and participants have order tasks, allocate times, and explain reasons behind decisions. Participant has to decide priorities, make decisions, read items, interpret and carry out sets of instructions all with interruptions and distractions. Very participant-centered with high transfer of learning.
- 21** Language laboratory: Individual booths equipped with audio program and linked to a central tutor. Good for early practices but cannot replace eventual need to practice in public. Increases confidence as embarrassment factor is less apparent.
- 22** Lecture: Structured, planned talk. Usually accompanied by visual aids, e.g., overhead projector slides (OHPs), Power Point slides, flip charts. A lively style is needed. Communication of material may be limited if no feedback to lecturer. Unless structure is carefully planned and is animated, audience will tend to lose attention.
- 23** Multimedia and video conferencing: Although hardware and software can be still expensive, this allows contact between distributed sites and where distance makes travel time and cost prohibitive. Allows two-way interactive communication.
- 24** Networked learning: A broad term that means learning is through the medium of ICT. Prepares individual for lifelong learning through ICT.
- 25** Open forum: Panel of experts with different views exchanged on the given topic. Allows participants to interact with outside experts and colleague expertise. Can deflect difficult questions away from trainers and facilitators.
- 26** Open learning: Courses and training schemes that are intended to meet the individual educational needs of learners. Makes education more flexible and also provides more equitable learning experience.
- 27** Outdoor development programmes: Dynamic open-air exercises that are usually carried out in teams. Traditionally for recreation pursuit but nowadays used for community projects. Some participants may not accept relevance of physical environment.
- 28** Problem- based learning (PBL): Large scale exercise, but leaving most of the process within learner discretion. Frequently involves collecting and reporting



data, then offering conclusions and recommendations for improvement. Stimulates analysis and creativity as well as reporting skills.

**29** Prompt list: List of questions to which a person should have answers. Good as a form of non-directed form of learning.

**30** Radio and TV broadcast: Often linked with national courses and qualifications (e.g., Open University). Viewing time may times unsociable but use of video equipment can overcome this.

**31** Real play: Real-play actors can be used to display difficult employee behavior or techniques of good management behavior to help coaching and appraisal skills. Allows better appreciation of reflective responses in customer-facing situations.

**32** Role- play: Enactment of role(s) in protected environment. Participants are asked to suspend self-reality and adopt other roles. Unless disciplined, can cause embarrassment. Can be good for video feedback.

**33** Role-reversal: Enactment of reversed roles by two or more learners in simulated situations. Needs discipline and realism.

**34** Self-managed learning: Also called self-paced learning. Learner paced, often augmented by audio/video tapes. Motivation often declines if material is 'dull'. Tutorial help can be important.

**35** Simulations: Attempts to represent a high degree of reality, often also termed as business or management 'games'. Games often have rules, players and are competitive. Permits more complex scenarios to develop that are close to real life, yet allows participants to practice and make mistakes in a safe environment. Generates feeling of interdependence.

**36** Study groups: Task-briefed groups that also practice process review, aided by a process consultant, who does not operate outside this role. Some learners dislike lack of structure. It may sometimes generate stress.

**37** Syndicate: Larger tasks and exercises involving planning and preparation. Divides the larger groups into smaller groups with separate rooms. Each of the groups is asked to discuss tasks and solve or identify a specific problem followed by a review. Allows groups to develop its strength and identify due to larger complex project.

**38** T-group training: 'T' stands for training. A form of process sensitivity training.

No tasks are set and group is required to examine and discuss ongoing process within itself. Can be frustrating but is worth working through-very rewarding.

**39** Virtual learning environment (VLE): Can be used to replace or supplement conventional classrooms, enabling learning to take place over internet with levels of face-to-face contact. Learners can undertake learning activity at convenient times and at their own pace.

**40** Virtual reality training: Enables creation of simulated environment for training purpose. User can learn by experience and 'explore' the environment they are trying to learn about without risk to health and safety.

**41** Web-based learning: Learning via internet and World Wide Web (WWW)-now a widely available resource. Allows users to learn at their own pace and in their own time. Exciting way to learn as the resources are extensive and tend to present information in clear manner.

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**Annex-7**  
**(Chapter 12 Clause 11)**

### **Typical Template for the Trainer for 180 Minute Training Session**

- 1           Learner outcome: I (trainer) will chart out the objective and course requirement so that I can get starting point for developing my lesson plan. This will include i) making a note of observable performance or behavior of learners. ii) Condition under which the task will be performed. iii) What will be my level of acceptable performance in respect of quantity and quality (within limited period of my session) from the learners which will be accepted.
  
- 2           Introduction: I allot 5 minutes in which I will introduce myself, explain my authority to convey why learner would like to listen to me, and open up the my session with some interesting anecdote (interest device) .
  
- 3           Objective: I allot 3 minutes in which I will help learners to visualize their goals and how the learning is going to help them in future.
  
- 4           Course Requirements: I allot 2 minutes in which learners are to be told as to what they must be able to do to pass the course, what level of task performance will be accepted by me.
  
- 5           Instruction outline: I allot 10 minutes in which I will give over all-view of instructions and stimulate prior recall of learning and tell how the present instructions are built upon learning already available with the learners.
  
- 6           First Learning point: I allot 20 minutes in which I will use full range of multiple intelligence style of learning. As I already know that my class comprises of Linguistic-verbal learners or logical mathematical learners or visual –spatial learners, or body kinesthetic learners etc. I will use instruction material which is best suited for the transfer of learning.
  
- 7           Second learning point: I allot 25 minutes in which I will use aids for long term memory such as mnemonics, visualizations, mind maps, or other activities to get learners involved. I use VAK to reinforce learning concepts. I evoke positive emotions for positive action outcome.
  
- 8           Third Learning Point: I allot 30 minutes. I know that there are four combinations of perceiving and processing which determine learning style. I use learning cycles of (a) Theorist for abstract conceptualization through lecture, notes, case study (b)



Pragmatist for concrete experience through laboratories, field work, observation (c) Activist for active experimentation like group discussion, simulation (d) reflector for reflective observation like journals, brainstorming.

**9** Fourth Learning Point: I allot 20 minutes. I use this period for making instructions to be absorbed by the learners using different learning styles.

**10** Eliciting performance: I allot 30 minutes to reinforce the learning absorption by the learners. I use clear instructions for Avid Beginners. For Intrapersonal Learners, I use activities that involve emotional processing, silent reflection methods, thinking strategies, concentration skills, higher order reasoning. For Naturalist Learners, I use activities relating to natural world like maps, outdoor observations. For Disillusioned Beginners, I try to find out the learning styles which work best for them and supply emotional support to build their confidence. For Reluctant Learners, I provide emotional support to keep their confidence level high but less technical support because these learners know that they can perform task well and have therefore developed reluctance to receiving instructions. For Task Performers, only little support is required from me as they have begun to take new tasks and responsibilities.

**11** Review: I allot 15 minutes after tea break in which I perform reflection or review activities either in group or individually to reinforce the transfer of learning in a general way and also ascertain the learning points which have been picked up by the learners as major concepts.

**12** Evaluation: I allot 20 minutes for judging whether the learner's behavior after the session support the learners outcome which I had kept as my learning objective.

**13** Retention and Transfer: I allot 10 minutes to appraise the learners as to how the newly acquired skills should be used for retention and transfer of knowledge.

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**Annex-8**  
**(Chapter 12 Clause 11)**

**Indicative Training Programme Module for Designing Flexible  
Overlays using FWD**

- 1        **Job:** Design Engineer
- 2        **Task:** Structural designs of flexible overlays on existing road reach
- 3        **Existing Performance:** Design based on Benkelman Beam Deflection Data (BBD).
- 4        **Desirable Performance:** Design based on Falling Weight Deflectometer (FWD).
- 5        **Performance Gap:** New SKAs needed for design based on falling weight Deflectometer (FWD) – existing SKAs sufficient for design based on Benkelman Beam Deflection method.
- 6        **Training Need:** Yes.
- 7        **Type of Trainees:** Logical mathematical.
- 8        **Instruction Techniques:** Handout material; Audio-visual presentation; Black board for charts, graphs, mathematical logic; Computer Aided Design demonstration, On-site demonstration, coaching for class room design exercise, reviewing transfer of learning by interaction at individual level, evaluation of learners behavior by checking their comfort level with newly learned design method, Instruction on how the newly acquired SKA to be retained by the trainees.
  - a) **Entry level performance evaluation.**
    - i) Knowledge of structural behavior of flexible pavement.
    - ii) Benkelman Beam Deflection (BBD) method technology.
      - System of Data collection.
      - Data interpretation.
      - Designing overlay based on data.
    - iii) Use of software for the design based on BBD method.

**b) Training Module:**

- i) Training objectives and expectation from the trainees
- ii) Overview of flexible pavement structural behavior
- iii) Overview of design using BBD
- iv) Explaining limitation of BBD like it does not simulate dynamic loading conditions that usually prevail on highways
- v) Explaining why there is need for rational evaluation of flexible pavement.
- vi) Overview of evolution of rational evaluation method. Studies done by experts, AASHTO Pavement Design Guide for FWD.
- vii) Clarification of various concepts used in FWD methods like layer stiffness, fatigue cracking, permanent deformation, modes of failure, layer moduli, road bed soil resilient modulus, concept of structural numbers for existing and future overlay surface, concept of pavement section as layered elastic system, concept of mechanistic criteria adopted by the IRC.
- viii) FWD Technology: FWD vehicle- details of equipments, computer, and velocity sensors.
- ix) Detailed explanation of method of computation like Genetic Algorithm (GA) based programme for effective moduli of pavement layers.
- x) Concept of input to GA based programme like measured deflection, radial distance of measured deflection, layer thickness, Poisson ratio value for different layers, applied load, loading platform radius.
- xi) Procedure for computation of layer moduli using software for in-service pavement, new pavement and new technology pavement.
- xii) On site demonstration of FWD vehicle, equipments, data collection.
- xiii) Class room designing of overlay thickness based on data collected from site.
- xvi) Reinforcement during class room design session through interaction as coach.
- xv) Reflection of newly acquired SKAs through interaction with trainees.



**ABBREVIATIONS**

BMS	Bridge Management System
BMS	Basic Minimum Services
BOT	Build-Operate-Transfer
BRO	Border Roads Organization
CCEA	Cabinet Committee on Economic Affairs
CDC	Consultancy Development Centre
CE	Chief Engineer
CEAI	Consulting Engineers Association of India
CIDC	Construction Industry Development Council
CPWD	Central Public Works Department
CRF	Central Road Fund
DBFO	Design Build Finance & Operate
DG(W)	Director General (CPWD)
ELO	Engineer Liaison Offices (MOSRTH)
FDI	Foreign Direct Investment
FIPB	Foreign Investment Promotion Board
FWD	Falling Weight Deflectometer
GBS	Gross Budgetary Support
GIS	Geographical Information System
GQ	Golden Quadrilateral (National Highway)
GS	General Staff
HDM	Highway Design Modeling
HR	Human Resource
IIM	Indian Institute of Management
IIT	Indian Institute of Technology
IRC	Indian Roads Congress
ITI	Industrial Training Institute
JBIC	Japan Bank for International Corporation
LPG	Liquefied Petroleum Gas
MCA	Model Concession Agreement
MDR	Major District Road
MNP	Minimum Needs Programme
MORD	Ministry of Rural Development

MOSRTH	Ministry of Shipping, Road Transport and Highways
MoU	Memorandum of Understanding
MOUD	Ministry of Urban Development
NS-EW	North South & East West
NGO	Non Government Organization
NHAI	National Highways Authority of India
NHDP	National Highways Development Project
NITHE	National Institute for Training of Highway Engineers
NQM	National Quality Monitors
NRRDA	National Rural Roads Development Agency
ODR	Other District Roads
PAR	Performance Appraisal Report
PIU	Programme Implementation Units
PMGSY	Pradhan Mantri Gram Sadak Yojana
PPP	Public Private Partnership
PWD	Public Works Department
QMS	Quality Monitoring System
R&D	Research & Development
REO	Rural Engineering Organizations
RMC	Road Management Corporation
RO	Regional Office
ROB	Road Over Bridge
RUB	Road Under Bridge
SAARC	South Asian Association for Regional Cooperation
SARDP-NE	Special Accelerated Road Development Programme for the North Eastern Region
SBD	Standard Bidding Document
SH	State Highway
SQM	State Quality Monitor
SRRDA	State Rural Road Development Agency
STA	State Technical Agency
VR	Village Road













(The Official amendments to this document would be published by the IRC in its periodical, 'Indian Highways' which shall be considered as effective and as part of the code/guidelines/manual, etc. from the date specified therein)